

**BOARD OF AGRICULTURE AND
FISHERIES.**

LEAFLETS.

SECTION 10

(REVISED SERIES).

**INSECT AND OTHER PESTS INJURIOUS TO
FRUIT
TREES AND BUSHES**

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LEAFLETS.

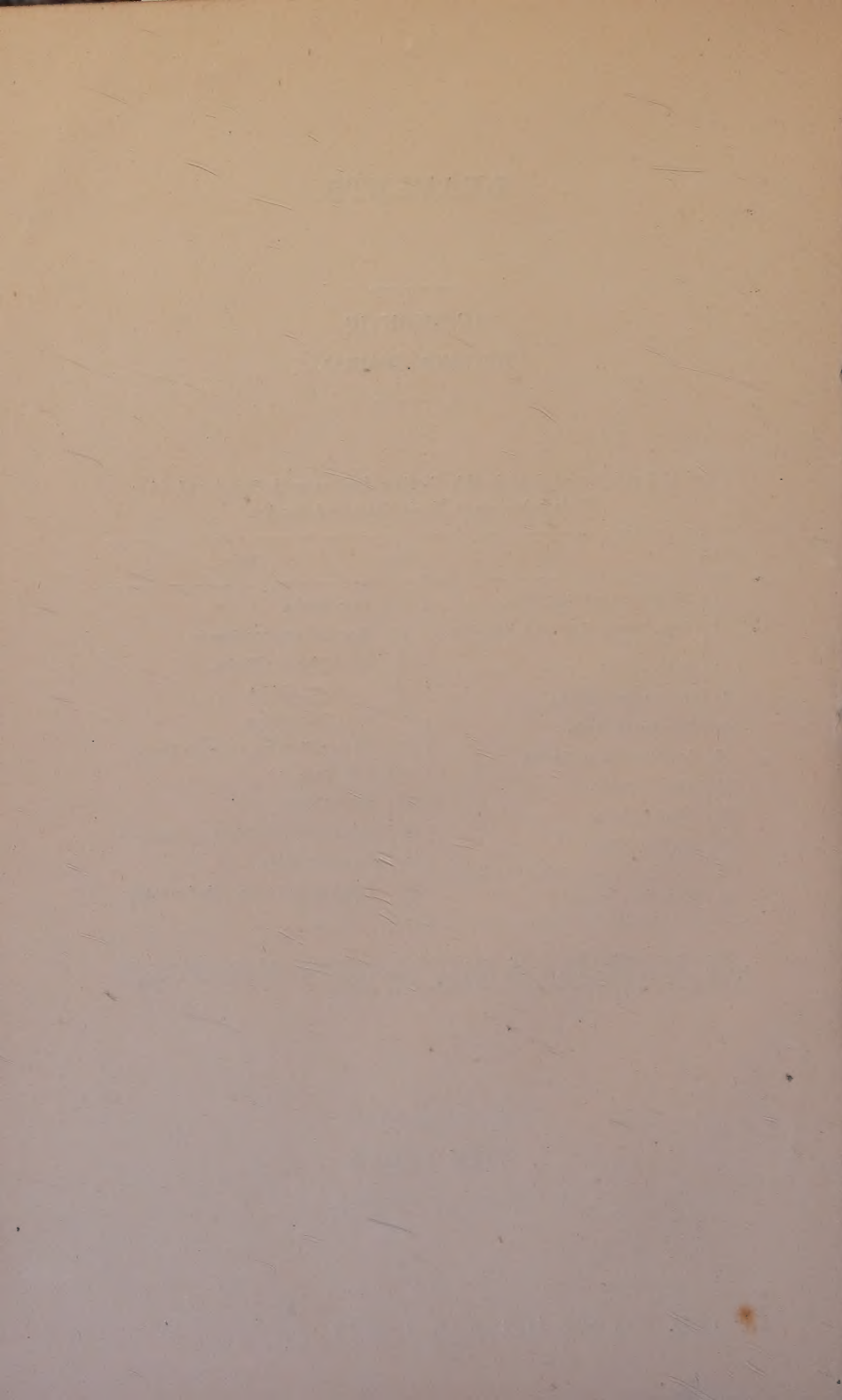
SECTION 10 (REVISED SERIES).

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Pests injurious to Fruit Trees and Bushes.*

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BOARD OF AGRICULTURE AND FISHERIES.

The Black Currant Gall Mite (*Eriophyes (Phytoptus) ribis*).

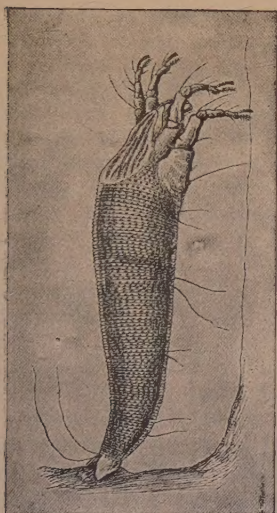


FIG. 1.



FIG. 2.

Fig. 1. Black currant mite (much magnified) erecting itself upon its terminal suckers (after E. J. Lewis). Fig. 2. Twig of black currant in which an uninjured bud has opened. Two lower buds are hindered by presence of mites, while the lower buds are swollen by them.

The so-called Big-Bud disease of the Black Currant due to this mite has been known in this country for at least 60 years, but latterly the disease has spread all over the country, and the damage done has been so great that in some districts black currant growing has ceased, the black currant being replaced by some other crop. All cultivated varieties of the black currant fall victims to the disease, which is caused by the presence in the buds of mites of the species *Eriophyes ribis*. As a result of the irritation caused by the presence of the mites and the pricking of the delicate young leaves by the mandibles of the mites in their feeding, the buds swell greatly and become somewhat rounded in shape. If the buds are badly infested then neither leaves nor flowers develop, the buds remain unopened, and

after retaining their green colour for a time they ultimately dry up and become brown. Buds containing a smaller number of mites may burst at the proper season, but the shoots and leaves are dwarfed.

The Mite belongs to the Class *Arachnida* (spiders, mites and scorpions), the Order *Acarina* (an Order numbering in it the red spiders, the mange mites and the ticks) and the Family *Eriophyidae*. These *Eriophyidae* are feeders on plants, and are distinguished from all other mites by their having a somewhat worm-like elongated body with only 4 legs, each leg having 5 joints.

Description.

The Mite.—The Mite is practically invisible to the naked eye, measuring in length scarcely 1-100th part of an inch. The body may be divided into two regions, a broad anterior cephalo-thorax, protected above by a furrowed shield and running out into a snout-like head bearing the piercing and sucking mouth-parts; and an elongated abdomen with a series of transverse rings with rows of projections on them. At the end of the abdomen are two rounded flaps which can be brought together to act as a muscular sucker by which the mite can erect and support itself. At the front end of the mite are 4 short legs; these legs are 5-jointed and bear bristles, the end joint being furnished with a claw. The body carries five pairs of bristles: a pair behind the legs; a longer pair about the middle of the body; a third pair, the shortest, on the under surface; a fourth pair, slightly longer, also on the underside of the body posteriorly; and a fifth pair, the longest of all, springing dorsally from the tail end and capable of service to the mite in locomotion.

The Mite is whitish or pale green in colour and has a glassy semi-transparent appearance.

The eggs are large for the size of the mite; they are greenish in colour and have a horny covering.

Life History.

Details of the life history have been worked out Lewis, Warburton, Embleton, and Collinge.

The mites feed and shelter in the buds over winter. Buds that have been only partially infested may open out in March, and the mites thus exposed and deprived of shelter may leave their hiding place. It is believed that most of the mites from this chance migration perish. The real migration of the year takes place from badly infested and destroyed buds, which do not expand, and from partially infested buds that have opened late. This migration takes place from about the middle of April onward—there are variations according to the season—increasing in intensity during May and spending itself

somewhat by the middle of June. It should be noted that this migratory period is the vulnerable period in the life of the mite—the time when treatment, to be successful, should be applied. During this time mites may be found in numbers on the shoots, at the bases of the leafstalks, on the flower-stalks, on the flowers, and in collections round the young buds which are to provide the new homes for the migrants.

Migration may take place by crawling or by the mites attaching themselves to passing insects and other animals. In waiting for such attachment, the mites are found occasionally to assume an upright position fastened by the sucker at their tail end. Where lodgment is not obtained on a passing animal the mite seems to launch itself into space, with the possibility of landing on or near a bud; most that fall to the ground in this way probably fail to get back to the bushes.

These migratory mites are adults, and, having entered the new buds and made their way inwards, the females—many of them already full of eggs—proceed to lay. The eggs hatch in due course, and buds crowded with the new generation show at the end of August and in September the characteristic swollen appearance.

Eggs have been found in the buds in all the months of the year, but in the winter months the number is comparatively small.

Preventive and Remedial Measures.

(1) The grower should cultivate from clean stock only, rejecting bushes that show swollen buds. Cuttings from infested plants should not be used.

(2) Where the disease is limited to a few bushes these should be uprooted and burned.

(3) Handpicking the swollen buds may, in an isolated area, keep the pest in check.

(4) Hard pruning followed by the removal by hand of suspiciously large buds has often been tried, sometimes with fair results, sometimes without manifest improvement.

(5) Fumigation with hydrocyanic acid gas has been experimented with, but the results are not such as to justify a recommendation of this treatment, especially in view of the difficulties attending fumigation over a wide area in the open.

(6) Dusting or spraying with a mixture of lime and sulphur. Very encouraging results—amounting in some cases to a cure—have attended the experiments of Collinge with the lime and sulphur treatment. The spray fluid used consisted of a mixture of 1 lb. of lime, 1 lb. of sulphur and 20 gallons of water. This treatment to be

successful must be thorough and repeated. More successful even than this was the dusting with lime and sulphur. One part of unslaked lime and 2 parts of flowers of sulphur should be mixed together and dusted three times on the bushes when they are wet, at the end of March or the beginning of April, again in the middle of April, and again in the first week of May.

To some extent the Black Currant Mite is kept down by natural enemies, such as the common ladybird (*Coccinella septempunctata*), the lacewing fly (*Chrysopa*, sp.), and a species of hover fly (*Syrphus*, sp.). The larva of a *Cecidomyid* and that of a *Muscid* have been found feeding in infested buds.

During the year 1907 Theobald recorded (through a correspondent) the fact that white currants and also red currants had been attacked by *Eriophyes ribis*. This attack should be noted, and bushes showing it should be burned.

4, Whitehall Place, London, S.W.,
April, 1894.

Revised, July, 1908.

The Board of Agriculture and Fisheries would be glad if recipients of this leaflet would make it known to others interested in the subject. Copies may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

Vine, Plum, Hop, and Raspberry Weevils.

The weevils included under the above heading comprise (1) the Black, or Vine Weevil (*Otiorhynchus sulcatus*, Fab.), (2) the Clay-coloured, or Raspberry Weevil (*Otiorhynchus picipes*, Fab.), (3), the Red-legged, or Plum Weevil (*Otiorhynchus tenebricosus*, Herbst.), and (4) the Ivy and Hop Weevil (*Liophlœus nubilus*, Fab.). Other species do damage, but the four named are the most abundant.

These weevils frequently do much harm to many plants and trees, among which may be noted vines, mangolds, peas, beans, young turnips, strawberries, raspberries, plums, cherries, peach and nectarine trees, and ferns and flowers of various kinds in pots and borders, in greenhouses or in the open air. In 1894 the first two of these weevils were unusually troublesome; the hot dry summer of 1893 appeared to be very favourable for their increase. Every year, however, there is more or less complaint. Hop plants are sometimes seriously injured by them, mainly, however, by the clay-coloured species (*O. picipes*), and the ivy and hop weevil (*L. nubilus*), though occasionally the dark-coloured species (*O. sulcatus*) is found on these plants. The hop bines flag, their heads droop just after they are tied to the poles, and they have deep punctures here and there. In some cases these punctures are so deep that the bines are nearly cut in two. In the same way the tender shoots of vines are punctured by the vine weevil, and the juicy sprouts of raspberry canes by the first three species mentioned above.

Besides the damage done to hop plants through the leading shoots of the bines being cut off or so weakened as to be practically useless, the "hills," or plant centres, are much injured by the grubs, or larvæ, which feed upon them during the late autumn and winter. This injury has in many cases been attributed to wireworms. The roots are especially damaged by the grubs of *O. picipes*, which burrow into them, and soon cause decay.

Strawberry growers often experience much loss from these beetles in the adult stage, but more particularly from the grubs or larvæ. The grubs burrow into, and feed on, the roots and crowns of the plants from September until March, and after April the weevils pierce the shoots and runners.

Gardeners who find such plants as dracænas, cinerarias, cyclamens, primulas, spiræas, sedums, and others, withering or dying in greenhouses and borders, should search among the roots for the white grubs of the weevils. If the young succulent shoots of vines are found to be pierced and nearly severed, it is certain that there are weevils in the soil near the vine stems, and action should be taken against them.

Peach, nectarine, apple and pear trees are frequently injured by weevils, which bite the shoots and cause the sap to escape just when it is required for the development of the fruit.

The Black, or Vine Weevil.

(*Otiorhynchus sulcatus*, Fab.)



FIG. 1.

Larva 1, 1a; pupa 2, 2a; weevil, 3, 3a; natural size and magnified.

Description.—This weevil is termed *sulcatus* because of the broad, deep furrow on its short rostrum. It is about two-fifths of an inch long, black, with greyish hairs upon the head and thorax, has reddish antennæ with clubbed apices, and dark coloured legs. The elytra have somewhat deep furrows with a few yellow hairs. No wings are present.

The legless larva is creamy white, and bears many brownish hairs; the jaws are yellow-brown; it lies curved in the manner shown in the figure. The pupa is yellowish-white in colour, and is covered with reddish hairs; it is not enclosed in a cocoon.

Life History.—Eggs are laid in the summer, and the grubs, or larvæ, are found, from the early autumn until March, in the earth near to, and among, the roots of plants. The pupal stage is assumed in the early spring, and according to Taschenberg lasts 14 days. The pupa is found at a depth of from $2\frac{1}{2}$ to 4 inches in the earth. When the weevil emerges, it at once attacks the plants near it, feeding only at night. When disturbed, it feigns death, and remains immovable for a long time. It is tenacious of life in an extraordinary degree, and in its weevil state disregards heat, cold, and the most pungent odours. Curtis says that nothing but boiling water and turpentine seems to annoy this insect.

The Clay-coloured, or Raspberry Weevil.

(*Otiorhynchus picipes*, Fab.)

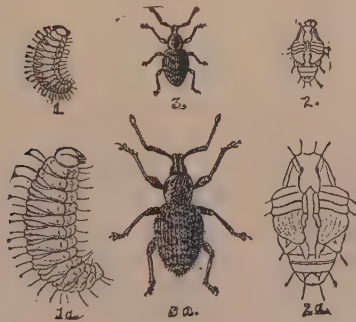


FIG. 2.

Larva, 1, 1a ; pupa, 2, 2a ; weevil, 3, 3a ; natural size and magnified.

Description.—The clay-coloured, or raspberry, weevil varies from one-fourth to a little under one-third of an inch in length. Its head and thorax are of a pitchy colour, and the elytra somewhat brown, but these are thickly covered with light-coloured scales, which make the weevil of the colour of clay, so that it is almost impossible to detect it in clayey soils. These scales, seen under the microscope, appear like beautiful mosaic or tessellated work. The weevil is rather ovate in form, and has dark-red or pitchy-red legs, as Schönherr describes them, with pitchy 12-jointed antennæ furnished with clubs. The femoral teeth, as Schönherr notes, are very indistinct, and in many cases imperceptible. There are long bristles upon the rostrum, and rows of short bristles down the furrowed elytra. This insect has no wings, and is a night feeder.

The legless larva is white or yellowish white in colour, is thickly covered with hair, and has a brown head.

Life History.—The life history resembles that of *O. sulcatus*. Eggs are laid in the ground and the larvæ feed on roots throughout the summer and autumn until the spring, when they change to whitish pupæ with black eyes.

The Plum, or Red Legged Weevil.

(*Otiorhynchus tenebriosus*, Herbst.)

Description.—In length the plum weevil, so-called because of its apparent partiality for plum foliage, varies considerably; the usual size is about half-an-inch long, but small specimens may be found two-fifths of an inch long. It is black in colour and shiny in appearance; the wing-cases bear lines of punctures, and in quite fresh specimens some ashy-grey scales; and the legs are dull red.

The eggs are at first white, but in two days become jet black.

The larvæ are very similar to the two former species.

The pupa is pale and brownish-white.

Life History.—This weevil is one of the most destructive to the plum, raspberry, strawberry, cherry, apricot, nectarine, and peach in the London district and the South and South-East of England, especially on chalk soils. The beetles strip the shoots of their leaves, destroy the buds, and even attack the bark, while their larvæ devour the rootlets and roots of the strawberry, &c. during the winter. Like the two species already mentioned, the plum weevil is mainly nocturnal in habits. The eggs are laid just under the ground; they hatch in August and September, and the larvæ remain feeding upon strawberry and other roots until the following March or April. The pupa is found in an earthen cell, and, as a rule, about $2\frac{1}{2}$ inches beneath the surface of the ground, where it remains from fourteen to twenty-one days. This weevil is apparently double brooded.

A closely related species (*O. fuscipes*, Walton) also works in a very similar way.

The Ivy and Hop Weevil.

(*Liophlæus nubilus*, Fab.)

Description.—The weevil varies considerably in size; small males occur only one-third of an inch in length, while some females are as much as three-fifths of an inch long. In colour it is black, densely covered with ashy-brown scales; the wing-cases bear small tessellated spots and punctured lines; and the legs are dark, and rather hairy.

Life History.—Several reports of the damage caused to hops by this weevil have been received from growers in Kent. This weevil lives in hedges, on various young trees

and on ivy and other plants. It damages hops by biting the bine, especially attacking the tender shoots. Like the other *Otiorhynchi* it works at night, hiding between the bine and the pole or in the earth of the "hills" during the day. It frequently becomes covered with the earth, in which it hides. Nothing seems to be known of its life history.

Preventive and Remedial Measures.

As the weevils described above feed upon many trees and plants, it will be found that they often come from hedgerows round fields cropped with hops, peas, beans, mangolds, turnips, or fruit bushes, and gradually infest these crops. In some hop gardens in Kent they spread from rows of poplars planted as shelters, or "lews," for the hop plants. In others they came from raspberry and currant plantations near. As they cannot fly, their progress is slow, and they should be prevented by active measures from advancing in fields where they are discovered.

1.—They may be caught upon hop plants and raspberry plants by holding tarred boards near the ground at night, and tapping the poles or stakes so that the insects fall into the tar.

2.—Some hop planters send men with lanterns to pick them from the hop bines at night. In this way many weevils may be caught.

3.—They would be disturbed by prong-hoeing close round the plants, and hoeing in lime and soot mixed together. A constant moving of the soil with nidgetts, horse-hoes, and hand-hoes, would tend to check the progress of the weevils in the case of hops, mangolds, peas, beans, and turnips.

4.—In infested hop-land and fruit-land, where the plants are permanent, besides constant hoeings and the application of caustic materials in May and June, when the weevils are active, the soil immediately round the plant centres and bushes should be treated in the autumn with lime and soot, or earth, sand, sawdust, or ashes saturated with paraffin oil at the rate of from four to five pints to a bushel.

5.—In strawberry fields it is most difficult to cope with these insects, but when infested fields are grubbed up they should not be replanted with strawberries for two or three years.

6.—Strawberry plants in gardens that have become infested with weevils should be examined closely in late autumn, and the grubs picked out from the roots as far as possible.

7.—In regard to strawberries, one point of importance to notice is that the beetles seek shelter beneath which to deposit their eggs, and this is readily found under the straw or grass put between the rows to keep the fruit from the earth. In all cases the straw should therefore be put on as late as possible, and cleared away as soon as the fruit is gathered.

8.—With regard to vines in houses, the weevils may be shaken at night on to tarred boards, or cloths spread under the vines, or they may be picked off them. The treatment must be repeated.

9.—Where peach, nectarine, and other wall fruit trees are attacked, the walls should be kept free from holes, and often whitewashed; the base of the wall should be thickly tarred, and ash and tar spread along the foot of the wall. The tarred boards may also be used at night, or the weevils may be picked off by hand.

10.—The roots of plants in pots should be freed from the grubs, and if there is an attack on flowers in borders their roots and the soil near them should be examined and the grubs picked out.

11.—For the destruction of weevil and other grubs at the roots of plants Theobald recommends watering with the following mixture:—"One quart of soft soap dissolved in one gallon of boiling soft water, to which add one pint of crude carbolic acid. Mix the whole, by means of a force pump, into an emulsion. For use add 30 times the amount of water to each part of the emulsion. The earth should be removed from the roots before watering."

Natural Enemies.

These weevils, although not materially checked by them, have several natural enemies. Amongst the most important are the so-called sand wasps, or *Odyneri*. These wasp-like insects provision their nests with the adult weevils, which they kill or paralyse with their sting, and upon these the wasp larvæ feed when hatched. One species (*Odynerus parietinus*) has frequently been observed carrying off the smaller of these weevils, and another hymenopteron (*Cerceris arenaria*) often does the same.

Blackbirds and thrushes also devour them.

4, Whitehall Place, London, S.W.,
June, 1894.

Revised, September, 1906.

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BOARD OF AGRICULTURE AND FISHERIES.

Winter Moths.



FIG. 1.



FIG. 2.

Fig. 1. Winter Moth (*Cheimatobia brumata*). Fig. 2. Great Winter Moth and Caterpillar (*Hibernia defoliaria*). Male Moth, winged; Female Moth, wingless. All natural size.

There are several moths whose wingless females crawl up the stems of fruit and forest trees in the autumn and early winter and spring and deposit eggs in the interstices of the rind of the twigs and branches. From these eggs caterpillars are hatched in the spring which bore into buds and eat the foliage and blossoms, and young green shoots, and, in conditions favourable to their development, cause much injury to the fruit crop. Among these moths the Winter Moth (*Cheimatobia brumata*) (Fig. 1), the Mottled Umber, or Great Winter Moth (*Hibernia defoliaria*) (Fig. 2), and the March Moth (*Anisopteryx aescularia*), are the principal offenders. In some seasons, especially in those when the progress of the leaves and blossoms is arrested by spells of cold weather, great mischief is caused by the caterpillars of these and other moths, the females of which are wingless. Sometimes the trees are left as bare as in winter, and are, besides, seriously injured for another season. The caterpillars attack apple, plum, damson, filbert and cob-nut trees, and occasionally currant and gooseberry bushes that are set under apple and plum trees in fruit plantations. They are also harmful in woods, feeding on the hazel, maple, hornbeam, lime, and oak.

Description and Life History.

About the second week of October, the two Winter Moths come from chrysalids in the ground, under and near the trees that were infested with caterpillars in the preceding

summer, and the wingless females crawl up the trees for the purpose of egg-laying.

The Moths.—The male of the Winter Moth measures 1 to 1½ inches in spread of fore-wings. These are grey-brown in colour with darker wavy lines. The hind wings are pale grey and are without markings.

The female moth has the wings so small that flight is impossible. The abdomen of the female is large and the legs long.

The Great Winter Moth is about twice as large as the Winter Moth. The male has the fore-wings pale brown or brown-yellow, each with two dark bands. The hind wings are paler and have a brown spot near their middle. Small dots show over the wing surface.

The wings of the female are practically abortive; the brown body has two dark spots on every segment.

The antennæ of the male are combed, those of the female simple.

The Eggs.—The eggs of the Winter Moth are very small, cylindrical, and at first of a light green colour, afterwards becoming red. They are placed in small groups, usually at the base of buds and on pruned surfaces, sometimes in the chinks of the rind of the branches and shoots, and fastened there with a sticky substance. From 150 to 200 eggs are laid by one female. The Great Winter Moth lays larger, rather rusty coloured, long eggs, and more in quantity (as many as 400), which are placed in lines, or small groups, according to circumstances.

The Caterpillars.—From the eggs the caterpillars come in the early spring, usually about the middle of March, and, as it appears, just before the buds begin to burst. The Winter Moth caterpillars are at first grey, with dark heads, and so small that it is difficult to see them. Later on they become greenish, with white stripes and brown heads, and are finally rather yellow. When full grown they are about three-quarters of an inch long. They, as well as those of the Great Winter Moth, are called "loopers," or "measurers," on account of the position they assume when moving. They have six true legs, and only two pairs of prolegs, one pair of these being at the hind end of the body, so that they can be easily distinguished from caterpillars of other moths. These larvæ eat bud, leaf, blossom, and fruit, and spin the blossom heads, and also the leaves, together, and live under their protection. When food fails, or when they are fully fed,—from May to June—they let themselves down by silken threads to the ground, in which they bury themselves. The moths of both species begin to appear in the first week in October, and may be seen throughout November and December, and even in January and February—depending on the weather.

The caterpillar of the Great Winter Moth is chestnut brown in colour, with a wavy dark stripe on each side of the brown; there is a tinge of yellow on the under part of the body. It is much larger than the Winter Moth caterpillar, being $1\frac{1}{2}$ inches in length (Fig. 2). These caterpillars, too, have the habit of letting themselves fall from the twigs, to hang by a silken thread. When the period of pupation arrives the caterpillar descends to the ground and changes to a chrysalis just below the surface.

Methods of Prevention.

1.—It is very necessary to adopt methods of prevention against these insects. The first and most important measure is to prevent the wingless female moths from crawling up the trees in the autumn and winter months. This can be effected by putting sticky compositions round the stems to entrap the moths.

Cart grease made from fat or oils, and without tar, is recommended as the best and safest composition to use for banding fruit trees. In all cases the grease must be spread on bands of grease-proof paper. These bands should be 6 inches wide, and tightly tied to the tree above and below by a piece of string. The bands are best placed four or five feet above the ground. If the trees are young and stakes are used, the stakes should be banded also.

Grease-banding must be commenced early in October, and the grease renewed from time to time when the composition has become dry and hard. If stout paper be used it may last for two years.

It will be necessary to keep the bands in good working order as long as moths are seen about.

In February or March, or as soon as frosty weather has gone, the wingless females of some other species of moths, *e.g.*, the March Moth (*Anisopteryx aescularia*) come forth, and ascend the trees for the purpose of laying eggs upon them. These other moths are not nearly so numerous as the Winter Moths, but it is necessary to keep the bands in working order for them also in some districts; it is desirable upon the breaking up of winter to observe whether the male moths are flying about the trees in the dusk, and, if they are seen, to put the bands in working order at once.

2.—In the case of cultivated fruit land, many of the chrysalids might be destroyed by digging or hoeing late in the summer the ground all round trees that were infested in the spring, and by digging or hoeing in lime or gas-lime.

3.—In grass orchards, the herbage should be close-fed off by sheep. Poultry should always be kept in orchards, for they devour many larvæ, and also the female moths as they

escape from the ground. Many fruit growers also recommend pigs, which help to keep the trees in a comparatively clean state by destroying insects in the ground.

Remedies against the Caterpillars.

To destroy the caterpillars spraying trees with arsenites is necessary. Small apple, plum, and damson trees, filberts, cobs, and fruit bushes can be easily sprayed by means of proper knapsack sprayers. Large trees beyond the reach of hand sprayers can be sprayed with hop-washing machines, but there are machines especially manufactured for this purpose.

Only arsenical sprays are of any use against the caterpillars. Two of these sprays are strongly recommended, viz., Paris green and arsenate of lead.

Paris green costs from 10d. to 1s. per lb. It should be obtained in the form of paste, which is safer than powder, and used at the rate of 1 lb. in 200 to 250 gallons of soft water, according to the age and condition of the foliage and the kind of tree sprayed. As Paris green does not dissolve in water the mixture must be kept constantly agitated so that it may be maintained of an uniform strength.

Arsenate of lead should also be bought in the paste form, the proportion recommended for spraying being 2 lb. to 50 gallons of water, or two even teaspoonfuls to a gallon of water, the whole being thoroughly mixed.

It is not advisable to spray with arsenical solutions when the trees are in blossom, unless the attack is very severe, or bees may be killed and blossom destroyed. As the object is not to dislodge the caterpillars, but to poison their food, the arsenical solutions should be made to fall like gentle mist upon the leaves, fine spray jets being used for this purpose.

Live stock may be kept in orchards where arsenical compounds have been used. Such compounds, however, must not be used where gooseberries for early picking, and herbs and vegetables for early use, are grown under the trees.

4, Whitehall Place, S.W.,
September, 1895.

Revised, August, 1908.

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BOARD OF AGRICULTURE AND FISHERIES.

The Gooseberry Saw-fly (*Nematus ribesii*, Curtis.).

FIG. 1.



Figures 1 and 2. Larva in the two last stages.
3. The Cocoon, 4. The Fly.

The Gooseberry Saw-fly is very troublesome in gooseberry plantations and gardens, and it also attacks red currant bushes, but not so frequently as gooseberry bushes. In many cases the leaves are quite cleared off, together with the young fruit, and unless the plague is checked it is sure to be renewed in succeeding seasons. When the pest has once become established in large plantations it can only be eradicated by wholesale methods. This insect is common in many European countries, and appeared in America and Canada about thirty-five years ago. It has now spread over the greater part of the American continent, according to Saunders, who believes that it was brought into America in the earth adhering to the roots of imported gooseberry and currant bushes.

Description.

The female saw-fly is rather more than a third of an inch in length and half an inch in spread of wings. The body is the colour of honey, the thorax having black spots and the

head being dark; the legs are yellowish, with the ends of the tibiae and the joints of the feet black; the wings are iridescent.

The male is smaller than the female, its body is much narrower, and the thorax and abdomen are nearly all black.

The eggs are greenish-white.

The larva is a 20-legged caterpillar, there being in addition to the six thoracic legs, 14 abdominal pro-legs; it measures at first about the twelfth of an inch, but when full grown nearly an inch; the head is disproportionately large. The colour of the caterpillar varies at different stages. When newly-hatched it is almost white or greenish-white, with a black head and a few black spots on the body; after the first moult the colour is green, with very numerous black spots, the head is black, and the legs are ringed with black. In the last stage of its life as larva, the colour is light green, with no spots, except the first and last segments, which are orange, while the head is pale.

The cocoon is oval in shape and brown or yellow-brown in colour, the enclosed *pupa* being green or yellow-green.

Life History.

The adults appear in April or early in May, and the females lay their eggs, which are very numerous, on the under side of the leaves close to the veins. The eggs are inserted into slight incisions; they are now and then laid along the edges of the leaf and are fastened with an adhesive substance. In about six days the eggs hatch and the young caterpillars feed in company on the leaf on which the eggs were laid, their presence being indicated by numerous small holes. They soon become distributed over other leaves and shoots. They feed for about four weeks and then the cocoons are spun, generally upon, or just beneath, the surface of the soil under the infested bushes; the cocoons of this first brood of caterpillars are occasionally found upon the stems and twigs of the bushes. In about 20 days the adults issue and proceed in turn to their egg-laying. There may be three generations in the year; the cocoons of the last brood of the year are found deeper in the ground than those of the earlier broods, and the caterpillars lie sheltering in them until the next spring, when pupation takes place.

Unfertilised females of this species sometimes lay eggs; the adults that result from such eggs are always males.

Treatment.

1.—The eggs are conspicuous, and the leaves bearing them should be collected and burnt; care should be taken that they are removed before the young caterpillars have crawled away and spread themselves over the plant.

2.—The following materials are effective against the feeding caterpillars :—

- a. *Hellebore* mixed with water in the proportion of one ounce to three gallons of water and two ounces of flour, and applied with a sprayer. Whilst being sprayed the mixture should be agitated so that the hellebore is kept in suspension. *Hellebore is poisonous*, and is dangerous if used within six weeks of the fruit being gathered.
- b. *Arsenate of Lead*, bought in the paste form. If this insecticide is employed it must only be used very early so that the fruit may not have a coating.
- c. *Paris Green* in the paste form, half an ounce to 10 gallons of water. This should not be used later than six weeks before the fruit is gathered.
- d. *Strong lime water* has been found serviceable. This should be put on in a fine spray directed over every part of the bush for some time.

3.—The surface soil under the bushes should be removed for a depth of two inches, in winter, and be buried deeply in a hole dug for the purpose; it should be replaced with fresh earth and manure. This is an excellent measure.

4.—The ground under and close around infested bushes should be dressed with quick-lime, in the autumn, and dug deeply.

5.—To prevent the adult saw-flies from coming up from the cocoons the earth round bushes that have been infested should be stamped or beaten down in early spring.

4, Whitehall Place, London, S.W.,
October, 1893.

Revised, May, 1908.

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BOARD OF AGRICULTURE AND FISHERIES.

The Raspberry Moth (*Lampronia rubiella*).



Moth and caterpillar, both magnified ; the lines show the natural size.

Both in England and Scotland the small red caterpillars of this moth, often called the Raspberry Stem-bud Caterpillar, are most destructive to raspberry canes. On many fruit farms the crop has been reduced by one-third or one-half in consequence of the attack of this insect, and much mischief is also often occasioned by it in gardens and allotments where patches of raspberry canes are cultivated. Upon close examination of the attacked raspberry canes it will be seen that the soft juicy part at the base of the buds has been eaten away, so as to injure the buds and prevent their foliage and sometimes the blossoms from being put forth. The larvæ also feed on the pith inside the terminal shoots ; the attacked shoots flag and then die away in a very characteristic manner. A hole in the cane at the base of the buds may often be noticed in which the pupa will be found ensconced, and sometimes the pupa may be found in the tunnelled shoot.

Description.

The Raspberry Moth, *Lampronia rubiella*, belongs to the group *Tineina*. It is a most beautiful moth, of a light brown colour, with a series of yellow dots and spots upon its forewings, the two most prominent being on the inner margin. The hinder wings are slightly lighter in colour, with light fringes. The head is yellowish-grey, and the antennæ dull brown. It measures barely half an inch across its wings, and its body is only about the fourth of an inch in length.

The caterpillar is close upon a quarter of an inch long, decidedly pink in colour for the most part, though the shade varies somewhat in individuals, and becomes more red in most larvæ as they get older. The head is black, and there is a patch of black divided in two on the first segment. It has three pairs of black feet on the thoracic segments. The pro-legs number four pairs, and there is a pair at the hind end.

The pupa is about the fourth of an inch long, tapering somewhat unusually, and it has a curious spine upon the back on the last segment; it is reddish-yellow in colour, the wing covers being paler, and the abdomen somewhat pink.

Life History.

The moths may be seen at the end of May, but more commonly in June, flying round the raspberry canes.

The moth places its eggs upon the flowers of the raspberry canes from the end of May to the middle of June. After five or six days the caterpillar may be found in the raised white receptacle upon which the fruit (or more correctly, the collection of little fruits composing the raspberry) is formed. The caterpillar does not appear to injure the fruit, nor, indeed, to feed at all at this time. In time the caterpillar makes its way out of the receptacle, either by crawling or by letting itself down by silken cords to the earth beneath the canes, and passes the winter in a flat white silken cocoon about $\frac{1}{2}$ of an inch in diameter. These cocoons may also be found in crevices in the poles and under the rough rind of the stems. The caterpillars leave their winter quarters on the first approach of spring*; according to Dr. Chapman they leave the cocoon early or late in March, according to the season. They crawl up the raspberry canes, and, getting to the buds, eat into these at their base, and, feeding upon them, make up for their long fast during the autumn and winter months.

When the time arrives for pupation, the caterpillar scoops out a hole in the pith of the cane, below the base of a bud, and here it turns to a chrysalis; the moth coming out in about 21 days.

Methods of Prevention and Remedies.

1.—The caterpillars hibernate just under the surface of the ground, around and among the stocks of the raspberry canes, and in crevices in the poles, &c., and, as has been shown, they remain there from about midsummer until March. Therefore, deeply forking the ground round and between the stocks with a pronged fork, or even hoeing it with a three-toothed hoe, would destroy some and bury others so deeply that they could not get out.

* In 1892 caterpillars of *Lampronia rubiella* were first found in raspberry buds on April 10th.

2.—Cutting back the canes after an attack, and, as far as possible, doing away with stakes will have a good effect.

3.—Dr. Chapman has suggested the following practical method of prevention: "The caterpillars are in the crown of the stock, or near it, and under rubbish there collected. Rake this away, and earth the stock up again, and you will thus bury them, and most will perish."

4.—Soot, lime, ashes, or soot and lime mixed, which form a pungent compound, might be forked or hoed into the ground in the autumn or winter.

5.—When raspberry canes in field culture are nearly all cut away, so that there are but few canes or stems left, it would be easy to put a little thick soft soap composition containing paraffin oil, or some other offensive stuff, with a large paint brush, at the beginning of March, upon the lower part of each cane that is left, in order to prevent the caterpillars from crawling up. This would also damage such caterpillars as may hibernate there.

6.—Cutting off and burning the infested canes while the caterpillars are in the buds between April and the beginning of June, would destroy many caterpillars and pupæ. This may be very freely done, as raspberry canes throw up plenty of shoots to take the place of those cut away, and infested canes bear little or no fruit.

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BOARD OF AGRICULTURE AND FISHERIES.

The Apple Blossom Weevil (*Anthonomus pomorum*).



a, Weevil, nat. size; *b*, magnified. *c*, Larva, nat. size; *d*, magnified. *e*, Pupa, nat. size; *f*, magnified. *g*, Larva in blossom bud.

This insect very frequently causes much harm to the apple crops, and in the last few years its injuries have much increased in fruit-producing districts. Close examination of the blossoms shows that the little creamy-white larvæ of the weevil are in the centres of the flowers (Fig. *g*), destroying their powers of fructification. The action of this weevil upon the fruit blossoms of apple and sometimes pear trees is often mistaken for the effects of white frosts, when the petals have become brown or rust-coloured; but if such blossoms are closely inspected, either the very pale yellow pupa of the weevil (Fig. *e*) will be found in them, or a little round hole in the side of the withered flower will be noticed, showing that the perfect weevil has eaten its way out of its cradle. Attacked blossoms readily fall when a tree is shaken, and very often naturally before the weevils escape. The beetle may remain some days in the dead blossom before it makes its exit.

Incredible damage is often caused by this weevil in apple and pear orchards in France. In some Departments, syndicates of defence against it have been formed, consisting of a committee in each Commune, to carry out a series of

operations calculated to destroy this dangerous enemy, as it is felt that it is only by united action among cultivators that such injurious insects can be stamped out.

Description.

The apple-blossom weevil is very small, only the fourth of an inch long, and the eighth of an inch in breadth (Figs. *a, b*). It is black, with down, or pubescence, of an ashy grey hue upon its body. Occasionally, specimens are found almost pitchy in colour. The thorax is black with coarse scanty white pubescence. The wing-cases have alternate bare and pubescent grey lines; behind the middle is a band composed of pale pubescence which is oblique, and forms, when the two wing-cases are closed, a characteristic pale V-shaped mark. There is a pale grey spot between the wing-cases in front. The legs are very dark reddish, almost black; the thighs of the first, or anterior, pair are large, and each is furnished with a formidable tooth. The middle and hind femora have a smaller tooth; the feet, or tarsi, are of a darker colour. The rostrum, or snout, is the most remarkable feature, being half as long as the body, slightly curved, and bearing the antennæ, which end in oval four-jointed clubs.

Like many other weevils, the apple blossom weevil falls down when disturbed, tucks in its legs and snout, and remains motionless, feigning death until the danger has passed.

The egg is yellowish and oval.

The larva, or grub, is without feet, and is about the third of an inch long (Figs. *c, d*). It is wrinkled, and white at first, gradually becoming creamy-white. It has a brown head with two little brown spots on the first segment.

The pupa is nearly a quarter of an inch long, of a very pale yellow colour, with a long beak, or rostrum, and the legs folded on the under side of its body (Figs. *e, f*).

Life History.

In the first warm days of spring, the weevils issue from their winter retreats, and find their way to the apple trees. Some authorities consider that the females seldom use their wings, and that only the males fly freely. Others hold that both sexes fly equally well.

The female, either by flying or crawling, finds her way to the blossom-buds of apple and sometimes pear trees, and boring a hole with her snout, puts one egg within each blossom bud, and carefully closes up the hole. A female lays from 15 to 50 eggs, but puts one only in each flower-bud. The process of laying one egg takes about three-quarters of an hour.

Oviposition in an individual female may extend over a fortnight at least. The eggs hatch in from five to nine days. The larva, which lies in the bud in a curved form, attacks the stamens and carpels, and soon causes the petals to wither; the flower-bud changes to a rusty hue and decays (forming the so called "capped" buds). The larva in from 8 to 20 days turns into a pupa, the pupal state lasting from 7 to 10 days, when the weevil appears and escapes by a hole which it bores through the petals.

After this, the weevils live among the leaves of the fruit trees. It is not known whether they feed upon the leaves. A French authority, Dr. Henneguy, concludes from careful observation that they do not feed at all, but live upon a reserve of fat, stored up in their bodies during their previous state. They are not seen after the end of September, retiring for hibernation to chinks in the bark of apple and other trees, or concealing themselves beneath lichenous and mossy growths upon their branches, as well as under stones and rubbish beneath and around the trees, and in other similar refuges.

According to natural instinct, the weevils do not appear until the weather is mild and the flower-buds have begun to swell. If the season is, and continues, warm and growing, the effects of the attack are usually of a slight character. But should the weather be cold and changeable, as is so often the case in Great Britain and the north and western parts of France, the flower-buds are slowly developed, and the weevils lay their full complement of eggs, the hatching of which takes place before the flowers are fully open. They do not appear ever to lay their eggs in an open flower.

Varieties of apple trees which blossom very early and very late are more likely to escape the attacks of the weevil than those of the main crop whose blossom comes late in May in ordinary seasons.

Methods of Prevention, and Remedies.

1.—One mode of prevention is to spray the limbs and branches of apple trees, in February, with caustic alkali wash to destroy the lichens and mosses which serve as harbours for this weevil and other insects (*vide* Leaflet No. 70).
• This can be thrown up over the trees by means of a syringing machine with a powerful pump.

2.—All long grass, leaves, and rubbish should be cleared away underneath fruit trees on grass land.

3.—It is difficult to employ insecticides and insectifuges advantageously for this insect, but it might be useful to spray trees subject to its attack with kerosene emulsion made by dissolving $\frac{1}{2}$ lb. of soft-soap in one gallon of boiling water, and pouring this while still boiling hot into

two gallons of paraffin, and churning violently until a butter-like mass results. For use dilute with thirty to forty parts of water. The emulsion should be sprayed over the trees in a fine mist. This might tend to prevent the weevils from egg-laying.

4.—A mode of decreasing the number of weevils consists in shaking the branches to make the insects fall on to cloths spread below. Cloths—old rick-cloths being best—may be cut and arranged so as to fit close round the trunks of the trees. Labourers can then shake the branches violently, with the aid of long poles with hooks at the ends. The cloths should be quickly swept with brooms, and the débris and the weevils shovelled into sacks. This must be done rapidly, before the weevils can get away. It is said that four men and two boys treated 110 trees in a day in this manner. If this is done, a still day should be chosen if possible.

From experiments made, it has been found necessary to perform this operation two or three times on each tree, as all the weevils cannot be shaken off at once. From a tree, for instance, from which at the first shaking 1,000 weevils had fallen, 385 were shaken off five hours later. In one orchard of 8 acres, having 347 trees, nearly 450,000 weevils were destroyed in three days, at a cost of 1*l*. A satisfactory crop of apples was obtained.

It should be pointed out that this operation must be carried out before the weevils have laid their eggs, and upon their first appearance, commencing with the earliest varieties of apple trees.

This mode of destroying the apple-blossom weevils might be advantageously practised in Great Britain. It need hardly be pointed out that the fruit growers in districts should combine to wage war in this fashion simultaneously, and with care and energy.

5.—Theobald recommends shaking down the attacked blossoms, which should be collected immediately, as should also any blossom that has fallen of itself, and burnt, for the destruction of the enclosed weevils.

4, Whitehall Place, London, S.W.,

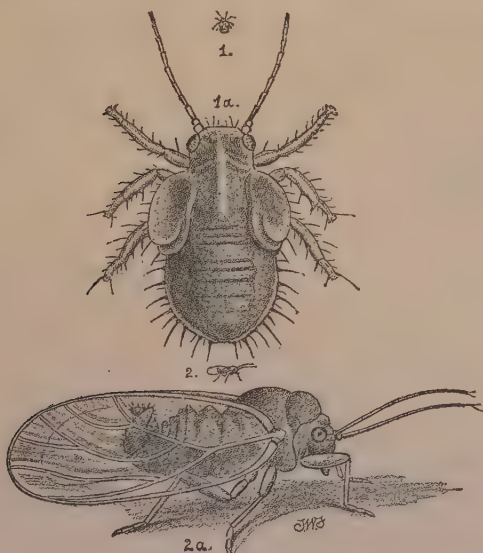
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BOARD OF AGRICULTURE AND FISHERIES.

The Apple Sucker (*Psylla mali*, Förster).



1, larva, nat. size. 1a, larva after third moult, much magnified. 2, perfect insect, nat. size. 2a, much magnified.

This insect is frequently the unsuspected cause of much injury to the apple crop. Its larvæ, which cause the mischief, are so small and so closely concealed in the buds, that they may be easily passed over by casual observers. Their action upon the flower and leaf buds is often confounded with that of their relation, the aphides, which appear at about the same time. Later in the spring they suck away the juices from the stalks of both blossoms and blossom-buds. These *Psylla* larvæ may be seen by careful inspection within the folds of the buds. Attached parts punctured by the beak of the pest are drained of their sap; they fail to develop, wither and fall off.

Although the *Psylla mali* has been known in Great Britain for a long while, it is only somewhat recently that it has been recognised as a serious trouble to apple growers. It is well known in many European countries. In Germany it has done considerable harm, and the well-known economic

entomologists, Schmidberger and Taschenberg, have written able treatises upon it. An allied species known as *Psylla pyricola* is very destructive in pear orchards in America, and has been elaborately described by Professor Slingerland, of the Cornell University Agricultural Experiment Station at Ithaca, in the State of New York.

Parts Attacked.

The leaf-buds, which may be destroyed.

The foliage leaves, which may be wrinkled, and become pale in colour and look frosted.

Flower-buds. Attack is worst on these, so that the collections of flower-buds do not expand and fruit fails.

From June onwards the adults may be seen on the leaves, but, in comparison with the earlier stages of the insect, they do little harm ; but they are the egg-producers.

In addition to symptoms of attack mentioned above the presence of the pest can also be recognised by small opaque globules in and about the unopened flower-buds. After a while, too, the buds become filled with a dirty sticky fluid termed "honey-dew" which issues from the larvæ and mingles with their excretions.

Description of Insect.

Many persons have, there is no doubt, noticed quantities of little yellowish, or greenish-yellow, fly-like insects upon the leaves of apple trees in September and October, which upon being approached give a leap before using their wings to carry them to another leaf. These, in a certain degree, resemble some of the "frog-hoppers" and, in fact, they have been mistaken for them, but close examination will show them to be very different.

The winged *Psylla*, the perfect insect, appears from the middle of May to the middle of June and later. Its colour is green, with slight tinges or shades of yellow. The colour, however, is rather variable, differing according to the sex, and time of year. At some periods there are shades of yellow, green, red, or brownish-red, noticeable upon the body. These are more pronounced at pairing time, and the female is more brightly coloured than the male. The wings are transparent, or slightly testaceous ; the legs and antennæ are yellow, the latter having two and sometimes four dark-coloured joints at the ends. The male is about one-twelfth of an inch, in length ; the female is slightly larger.

The eggs are white or slightly yellow, and somewhat spindle-shaped ; a thread-like appendage occurs at the pointed end. Taschenberg says that they become red, or yellowish-red, in the spring, just before the larvæ emerge from them.

The *larvæ* on hatching are very small, and have flat dirty yellow bodies, with brown or dark spots upon them. Their eyes are red and their feet brown. The changes in colour and form that accompany development will be noted under the life history.

Life History.

Pairing takes place in September, and the egg-laying may continue to November. In autumn of the abnormal year 1893 females were seen laying eggs as late as the 3rd of November. As a rule, the eggs are laid singly, and imbedded in the fine hairs upon the epidermis of the shoots. Occasionally there are two or three together in a row. The eggs are generally laid upon the youngest shoots. They are also placed upon older shoots and upon branches, but are then difficult to discover on account of the deep furrows and cracks, and mossy and lichenous growths.

The eggs remain until the weather becomes spring-like, when tiny flat *larvæ* emerge from them and at once get into the nearest buds. In the course of development of the *larvæ* several moults take place. The first moult soon occurs, after which the larva protrudes a small white globule, which remains attached by a white thread to its body. Should this be removed, another speedily forms. After a few days, when the second moult is accomplished, the larva becomes light green, and numerous white threads are produced forming a tangled mass, with which the larva covers itself. After about another week, with the third moult, the rudimentary wings are developed, as seen in Fig. 1*a*, and the eyes and tips of the antennæ become dark. This is the nymph stage. From the first appearance of the larva and until it is about a month old, there are continuous changes in its form. At the end of this time the nymph moults and the winged *Psylla* appears. The perfect *Psylla* appearing in May and June is said not to pair till September. Taschenberg inclines to the belief that there may be another generation during the summer, and it certainly is strange that the insect should pass so many weeks in apparent inactivity. Schmidberger, however, does not hint at a second generation, and no such brood has been observed in Great Britain.

Prevention and Remedies.

The times when measures may be taken with best results against the Apple Sucker are in the early spring and autumn.

1.—In the case of the early sorts of apples, infested trees should be sprayed with Paraffin Emulsion directly the apples

have been picked, to prevent the *Psylla* from laying eggs upon the shoots, and to kill the adults. The formula for Paraffin Emulsion is :—

Paraffin	...	...	2 gallons,
Water ...	...	...	1 gallon,
Soft Soap	...	...	$\frac{1}{2}$ lb.

Boil together the soft soap and water, and while still boiling hot pour into the paraffin; churn thoroughly by means of a force pump till a creamy butter-like mass results. The thorough churning is important, as, if properly made, the stock keeps for a long time. For use, dilute with 10 gallons of water.

2.—Carbolic acid might be used at the rate of from 2 to 3 gallons to 100 gallons of water, and 6 lbs. of soft soap.

3.—For a winter spray the caustic alkali fluid described in Leaflet No. 70 is recommended, but proof is still wanting that this destroys the eggs.

4.—Spraying when the buds are open, and the larvæ are exposed, would be efficacious if carefully performed. The wash would run down into the bases of the open flower buds and of the expanded leaf-buds, and make the quarters of the insects unpleasant, or destroy some of them. The paraffin and the carbolic washes would kill the larvæ with which they come in contact. If the paraffin emulsion spray be used at this time the stock when made must be diluted with 30 times the amount of water. Spraying should be done as early as possible in the course of the attack, before much "honey-dew," which would hinder the action of the washes, has been exuded.

5.—Some small amount of prevention would ensue from pruning trees on which eggs had been laid. On young small trees, bushes, and pyramids, this might be adopted, and it would probably be advantageous to prune them, if infested, more closely than usual. But in the case of large orchard trees, it would be impossible to rely upon this mode of prevention. It is most important that all prunings should be burnt.

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BOARD OF AGRICULTURE AND FISHERIES.

The Magpie Moth (*Abraxas grossulariata*).



1, Moth ; 2, Caterpillar ; 3, Cocoon. All natural size.

The caterpillars of this moth, called the "Magpie Moth" from its peculiar markings, often cause serious injury to the gooseberry and currant crops. They are sometimes also destructive to apricot trees, and are frequently found upon the plum, sloe, bramble, and hazel. The attacks of these caterpillars upon gooseberry and currant bushes are often confounded with those of the larvæ of the Gooseberry- and Currant-Sawfly, *Nematus ribesii*, but they are essentially distinct. The insects differ materially in every stage. In the winged state there are no points of resemblance, and in the larval conditions the *Abraxas* caterpillars are different in size, colour, and shape, from the grubs of the sawfly. Their habits also are distinct, for the caterpillars of the Magpie Moth live through the winter in the larval state, and are ready to attack the fruit bushes directly there is a vestige of green upon them, whereas the sawfly grubs are hatched from eggs laid by the female flies upon the leaves in the spring, and do not, therefore, appear until vegetation is well advanced.

When the Magpie Moth gets a footing in fruit plantations and gardens it is most important that active steps should at

once be taken to arrest its progress. Some years it is unusually prevalent and every year there is some complaint regarding it.

Description.

The Moth *Abraxas grossulariata*, which belongs to the *Geometridæ*, is a very pretty insect, nearly one inch and three-quarters across the wings, and over an inch long in the body. It varies greatly in colouring, but the typical moth has a yellowish body with a black spot on the thorax and a row of six black spots along its back. The fore wings have a white ground, with many black spots dotted irregularly upon them, with yellow blotches at their bases and an orange coloured band beyond the middle. In some specimens the black spots on the fore wings are almost confluent, while in others they are few and far between. The hinder wings are white with black spots round the margins, and other black spots placed irregularly upon them. The head is black, with short antennæ.

The egg is yellow and somewhat broad, with rows of dots upon it.

The caterpillar, when adult, somewhat curiously resembles the parent moth in its distinctive markings and coloration. It has a black head, and its body is whitish-yellow with a row of variously shaped large black spots along its back, and a row of much smaller black spots on the upper part of each of its sides. There is also a continuous band of a dark orange colour running from head to tail on each side, and below this another row of black spots, and two narrow black stripes underneath the body. The first two and last two segments are somewhat coloured with orange. There are three pairs of claw feet, which are black, and only two pairs of sucker feet, so that it progresses by a series of loops. It is an inch and a quarter in length when fully extended. The wintering larvæ of the first year are about half an inch long and much darker than the full grown larva.

The pupa is black and has three rings of a golden colour at the extremity, and other rings not complete. It is sometimes fastened to the leaves or stems by means of threads, or the caterpillar lets itself down to the ground and pupates there under leaves, weeds, or clods, and on walls.

Life History.

The Magpie Moth appears late in the summer, and places eggs upon gooseberry and currant leaves, near the midribs, in groups of three or four, or singly. In about 11 days the caterpillars come forth and feed for a brief period upon the foliage, previous to their going into winter quarters.

From the smallness of the caterpillars and the age and condition of the leaves it is clear that this is not the time when the pests do their worst work. The caterpillars either spin leaves together and, ensconcing themselves in them, fall to the ground with the leaves, or they drop to the ground and get just under its surface. Where currant bushes grow against walls and fences in gardens, a favourite place for the larvæ to hibernate is in any crack or crevice between the bricks or boards. They also winter amongst the dead leaves that get caught up in the forks and burrs of the bushes. They thus remain in the larval state until the early spring, when they ascend the bushes, and proceed to devour the young and juicy leafage, doing at this time the greatest damage. When full fed, which is generally in late May and June, they turn into chrysalids in a light cocoon, and the moths emerge in due time and place eggs upon the leaves of the gooseberry and currant bushes during August.

Methods of Prevention and Remedies.

1.—Warning is given of a coming attack of this insect by the appearance of the caterpillars in the autumn upon the gooseberry and currant bushes, showing that infestation may be expected in the following spring. When the caterpillars have been thus seen in the autumn, the ground beneath the bushes should be covered with finely powdered quicklime and dug deeply in the early days of winter. The fruit bushes should be previously pruned in order that any caterpillars that have "spun up" on the branches and shoots may be cut away or dislodged. If it is found after pruning that there are many caterpillars on the bushes it would pay to hand-pick them. All the cuttings from infested bushes should be collected and burnt. Winter washing with caustic alkali wash (*See* Leaflet No. 70) would destroy those hibernating in the forks.

2.—In the early spring, and before the leaves appear, the ground round the bushes should be hoed, the soil pulverized with prong hoes, and more lime, or a mixture consisting of two bushels of lime to one of soot, applied.

3.—Hand-picking may be also adopted in the spring in gardens and on small fruit farms where the infestation is serious. But in large plantations spraying should be the remedy.

4.—As the caterpillars of the Magpie Moth, like all larvæ of Lepidoptera, are mandibulate or biting insects, they should be destroyed by poisonous sprays such as arsenates. For this, either Paris green or arsenate of lead may be used. These sprays must not, of course, be employed on ripe or ripening fruit, but may be safely used at any time

four weeks before the fruit is gathered. In the case of attack of the Magpie Moth caterpillar, the earlier the spraying is carried out the better, after the leaves have commenced to show. What would be better still in gardens and plantations where this pest occurs would be to give a heavy arsenical spraying in the autumn, about the first or second week in September, so as to kill the young larvæ soon after their exit from the egg, when they are most delicate.

Paris green should be obtained in the paste form, and may be used at the rate of 1 lb. to 200 gallons of soft water in the autumn; in the spring at the rate of 1 lb. to 250 gallons. The spray fluid should be kept well mixed, as *Paris green* does not dissolve in water.

Arsenate of lead should also be obtained in the paste form, the proportion recommended for use being 2 lb. to 50 gallons of water, or 2 even teaspoonfuls to a gallon of water, the whole being thoroughly mixed.

5.—Washing with quassia and soft soap has been tried, but is not of much use in caterpillar attack.

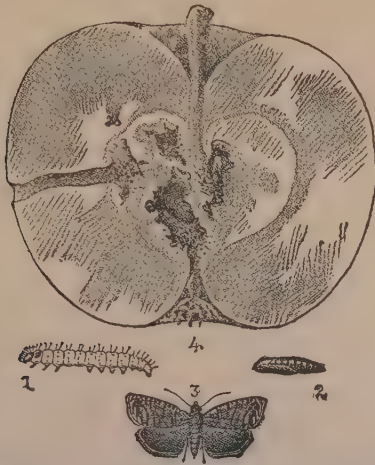
4, Whitehall Place, S.W.,
October, 1895.

Revised, August, 1908.

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BOARD OF AGRICULTURE AND FISHERIES.

The Codling Moth (*Carpocapsa pomonella*. L.).



1, Caterpillar ; 2, Pupa ; 3, Moth. All natural size.
4, Section of Apple showing work of Caterpillar.

This is a very small moth, but its caterpillars are, in most seasons, exceedingly destructive to the apple crop. They bore into the fruit and cause it either to drop prematurely or to decay rapidly when it is stored. Sometimes apples attacked by this insect drop off as early as the end of June, and continue to drop throughout the summer. Upon examining apples that have dropped, or those that show signs of decay in the apple-house or store, it will generally be seen that there is a dark spot at the blossom end of the apple ; a small hole can also be detected here, round which there is a collection of excreta and minute morsels of apple. If such apples are split in half, a passage will be seen leading to the core, around which there is usually a mass of refuse ("frass") ; and it will as a rule be discovered that the seeds, or parts of them, have been eaten. If the caterpillar is still in the apple, it will be found near the seeds, which appear to be the objects of its attack. If the caterpillar has forsaken the apple, a hole will be found on the side or some other part of the fruit, through which it has escaped.

Though this is called the "Codling moth," it by no means confines its attacks to Codlings, but was probably thus named because Codlings and some of their varieties, the Keswick Codling, for instance, are somewhat early, and, being large apples, make a great show on the ground when they fall. Varieties of apples having deep, open "eyes," and large dried tufts of the calyces surrounding them, like the Codling, the King Pippin, the Blenheim Orange, Margil, and Cox's Orange Pippin, are more liable to be infested than varieties like the

Golden Knob, Russet, Nonpareil, and others, the "eyes" of which are more closed up. This insect also attacks pears, sometimes rather severely.

This attack is not always recognised as being due to insect agency. It frequently happens that an unusual fall of apples is said to be the "summer drop," attributable to want of vigour in the tree, or to the weather. No trouble is taken to examine the dropped fruit, and the caterpillars escape from it in due time and conceal themselves, in order to pupate and produce moths for another attack. When infested fruit is taken into store-rooms, the caterpillars creep out and get into chinks and crannies in the walls and floors, from which the moths come forth and fly to the nearest apple trees in the following spring.

The Codling moth is very troublesome in France, Germany, America, Canada, Australia, and Tasmania. In the last-named country it is so destructive that the Legislature has passed an Act for its repression.

Description.

The moth (Fig. 3) is not quite three-fourths of an inch across the wings, and is about the third of an inch in length of body. The fore wings are deep grey, with many wavy lines of a brown hue. At their extremities there are oval patches of a deep golden colour, by which this moth can be easily identified. Its hinder wings are darker, having a golden tinge, and a lustrous shimmer. When the moth is at rest during the day, it is an insignificant object, sitting on the trunks and branches of apple trees, or on railings, fences, and hedges, with its wings folded in the form of a roof over its body.

The egg is flat and somewhat oval in shape, more like a scale than an egg, and about the size of a small pin's head. When first laid it is pearly white but later a reddish ring shows on it.

The caterpillar is at first greyish white in colour, with a shining black head, three pairs of claw feet, four pairs of sucker feet in the middle of the body, and a pair at the end. When full grown (Fig. 1), it is nearly three-quarters of an inch long, the head being brown and the body flesh-coloured or light pink.

The pupa is yellow-brown with spines on the abdominal segments; these spines aid in pushing the pupa out of the cocoon previous to the emergence of the moth.

Life History.

The moths appear about the end of May, flying from place to place and from tree to tree in the late afternoon and evening, the females placing their eggs singly upon the apple when these are about half-an-inch in diameter. In the American literature there are records of the eggs being laid on leaves, not only in experimental breeding cages but also in the open. The number of eggs laid by one female may, perhaps, be 50. After a week to ten days or longer—according to the weather—the

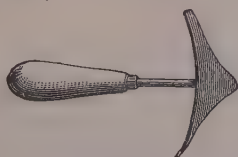
caterpillar hatches out. It enters the apple at the "eye" or calyx and tunnels to the centre to the seeds upon which it feeds, pushing back, in its progress, morsels of core, pulp and excrement, to the outside. Occasionally the caterpillar enters at other parts of the apple, *e.g.*, at the side and, it may even be, at the stalk end; entrance may be made also where two apples touch. From about three weeks to a month may be reckoned as the average duration of the active larval stage.

After the caterpillar is full grown, and has eaten the greater part of the seeds and the flesh round the core, it bores a hole from the centre to the rind of the apple, through which it makes its exit. If the apple is on the ground, the caterpillar on leaving hides itself underneath any rubbish, or crawls away to a neighbouring stem. Should the apple be still upon the tree, the caterpillar crawls down the branches and stem, or lowers itself to the ground by a silken thread. Large numbers of caterpillars pass the winter on the stems, where they construct cocoons with little bits of bark knit together with silk, or composed of silk alone; they may simply get into a convenient crack or crevice in the bark, and surround themselves with a silk case, gummed over with a sticky fluid. Sometimes the larvæ conceal themselves in cracks in posts and fences, or under the bark of trees, under cover of bands on the tree or anything leaning on the tree, and even under rubbish and dead leaves, and pieces of branches and twigs near the trees. When the caterpillar is taken in the apples into the apple store, or apple house, it comes from them in due time, and hides underneath any woodwork, or in cracks in the walls or floor.

The caterpillar does not usually pupate until the first approach of spring. There is normally only one brood in a season, but in some cases there are two.

Methods of Prevention and Remedies.

I. In order to induce the caterpillars that are crawling up or down the apple trees to congregate at certain points, bands made of old oil-cake bags, well-washed manure bags or hay ropes, should be tied tightly round the stems close to the ground early in July. To make these fit closely to the trees, and also to remove the temptation for the caterpillar to conceal itself before it reaches the band, all rough bark must be scraped off by means of a suitable implement. This banding is practised to a large extent in America, Canada, and Tasmania. It is made compulsory by law in the last-named country,



Bark Scraper

as well as in California, that apple trees should be banded in this way in early summer. These traps must be examined

at frequent intervals in summer and autumn, and the caterpillars in the folds of the bands destroyed.

II. "Windfalls" or "drops" must be cleared away as soon as possible, and should be disposed of at once: if not fit for sale, they should be given to pigs. In orchards, sheep, pigs, and poultry are useful, as they generally eat the "drops" and maggots as fast as they fall. Where cider is made, the ground where apples have lain in heaps should be well gas-limed and dug deeply, and all rubbish near burned. The walls of apple-rooms and stores where the apples have appeared to be infested should be well swept and lime-washed in early spring. The floors, also, and shelves should be well scrubbed with soft soap, and fine netting fixed over windows and ventilators to prevent the moths from escaping.

III. Spraying the trees with caustic alkali wash in winter does much good, by removing the rough bark, &c., beneath which the larvæ are hibernating.

IV. Spraying with Arsenical sprays so that the young caterpillars may be poisoned before they gain entrance to the fruit. There are two sprays which can be used for this purpose:—Paris Green and Arsenate of Lead. The trees should be sprayed directly the blossom has fallen, not later than a week. This is because the calyx or eye remains open for that time and the fruitlets are upright in position; the arsenic thus lodges in the eye, and when the calyx lobes close over they keep the poison in position. Spraying after the eye is closed is of doubtful benefit.

For the *Paris Green spray* use 1 lb. of Paris Green, 1 to 2 lbs. of freshly slaked lime and 200 gallons of water.

The *Arsenate of Lead spray* is made as follows:—Dissolve 1 ounce of arsenate of soda in a little water, dissolve 3 ounces of acetate of lead also in water. Pour these two into 10 gallons of soft water: 1 lb. of treacle added helps to make the liquid stick.

V. The blue and other tits, as also poultry, do much good in orchards by devouring the larvæ.

VI. All rubbish and dead wood should be cleared away from apple trees. It is most desirable that all barrels that have brought apples from abroad should be burned, especially those consigned to country towns, as many of these have caterpillars or pupæ in their cracks, which produce moths. This would help to prevent the constant fresh importations of this pest into the country.

4, Whitehall Place, London, S.W.,

June, 1896.

Revised, September, 1905.

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BOARD OF AGRICULTURE AND FISHERIES.

The Woolly Aphis, or Apple Root Louse.
(*Schizoneura lanigera*.)



1. Winged female, magnified; and line showing natural size. 2. Wingless viviparous female, magnified.* 3. Apple twig, covered by woolly aphides.

Distribution.

This insect is always more or less abundant in old and neglected orchards and apple plantations where the trees are unpruned and are covered with moss, lichens, &c. Unfortunately this pest is also sometimes seen in orchards recently planted. Nursery stock is frequently unwittingly sent out with families of the Woolly Aphis on the plants. It is especially on such young material that these plant-lice do so much damage. Dispersal by the agency of wind is not unimportant, but by far the most common way for the pest to be distributed is on infested nursery stock. Not only has the Woolly Aphis been carried from orchard to orchard in Britain in this way, but also from country to country, until it is now found in every part of the world where apples are grown. This Woolly Aphis, although termed also the American Blight, was originally a European insect; it is now a cosmopolitan pest.

* Figure 2 is reproduced, with permission, from Mr. G. B. Buckton's "British Aphides."

Injury caused.

Not only is the apple attacked but the pear is also sometimes affected. All varieties of apple in this country are subject to the ravages of Woolly Aphis, but perhaps the old Ribston Pippin suffers most of all. The Blenheim Orange, Cox's Orange Pippin, and Lord Suffield also suffer severely. Those trees with a soft rind are most affected. Certain experiments conducted in Victoria tend to show that with apples grafted on Majetin and Northern Spy stocks the roots are free from attack.

Infestation may be on the main trunk, on the branches, or *on the roots*; in overwhelming attack the leaves are also infested. The fact that the Woolly Aphis lives below ground on the roots should be carefully noted, as the above-ground parts, though cleared of the insect by treatment, may, unless treatment has been extended to the root-infesting individuals, receive a new infection as a result of migration from below. In America the subterranean form has been called the Apple Root Louse, and Professor Stedman of Missouri has shown that there can be migration from the trunk to the root, and from the root above-ground to the trunk.

The Woolly Aphis feeds, like all aphides, by puncturing the epidermal tissue and then draining away the sap by means of its proboscis. Not only is the tree weakened, but swellings or galls result which later on crack, an appearance being produced resembling the lesions caused by the canker-fungus. Sheltered in the canker-like cracks, the aphides are more difficult to reach by treatment.

Description and Life History.

The Woolly Aphis belongs to the genus *Schizoneura*. The arrangement of the nerves or veins on the wings is utilised to distinguish between different groups of aphides. The chief vein of the fore-wings gives off three branches; the branch furthest away from the insertion of the wing forks into two in members of the genus *Schizoneura*, and this distinguishes *Schizoneura* from another aphis that infests the apple, viz., *Aphis pomi*. Again, while *Aphis pomi* has projecting from its back two tubes known as cornicles or honey tubes, these tubes are absent in *Schizoneura*.

The Woolly Aphis may readily be recognized in an orchard* by the masses of white woolly substance formed by the larvæ and females which are sheltering in the crevices of the bark. The woolly substance arises as an excretion from glands in the back of both the young and mature females. It may often be seen hanging in festoons from the trees. Parts of this "wool" get blown off and are carried by the wind, often for some little distance, and in this material young *Schizoneuræ* may be carried.

Various forms of the Woolly Aphis are found in the course of the year's cycle:—wingless females that produce live young; winged females that are also viviparous; and males without wings, which pair with wingless egg-laying females.

The wingless viviparous females are oval in shape and purplish-brown in colour. Numerous white threads pass from their backs. Their antennæ and legs are very short, and in colour are dark reddish-brown to black. Such wingless viviparous females may be found all the year round. They give rise to great numbers of young (so-called lice) which are at first of a dull yellowish colour but later become purple-brown. It is the woolly material secreted by these that gives rise to the festoons mentioned above. These lice on becoming adult produce live young in turn, and a number of such generations can be produced in the summer.

Winged females may appear from July till September. These females are dark chocolate-brown in colour; they assist in spreading the infestation. This winged generation does not appear to arise commonly. Mr. Theobald mentions having found the winged females once. During the season of 1907 a careful observer, specially on the look out for this winged generation in a district where Woolly Blight abounded, failed to find the winged females.

The wingless males and wingless egg-laying females occur towards the end of the season. They have no piercing proboscis. The egg-laying female is reddish-yellow in colour and is very small, seldom exceeding .003 of an inch. One egg is laid and then the female dies.

The eggs are laid in crevices in the bark, near the base of the tree, and remain unhatched until the next spring; the larvæ from the eggs develop into wingless viviparous females. The number of sexual individuals seems to be small. Mr. Theobald says,* "As far as observations carried on over the past 20 years go, I can only say that this sexual brood is extremely rare in this country. Twice in 12 years it has occurred on one tree constantly kept under observation."

It is from viviparous females, hibernating under cover of crevice and moss and lichen, that the next year's generation chiefly springs.

Natural Enemies.

There are not many natural enemies that do much good in checking the increase of this pest. Possibly the woolly excretions and oily globules that surround the insect keep off the various foes which attack unprotected plant-lice.

The larvæ of Lady-birds (*Coccinellidæ*) devour them, as also do the adult Lady-birds. Larvæ of several species of Hover Flies (*Syrphidæ*) also feed upon them, but not

* Report on Economic Zoology for the year ending April 1st, 1907 page 34.

to the same extent as upon other plant-lice. Lace Wing Flies and Ichneumon Flies are seldom found attacking them. Small dipterous larvæ of the genus *Pipiza* feed on the subterranean form. Perhaps the Tits (*Paridæ*) do most good in keeping down this pest. These little birds, especially the Blue Tit, do inestimable good by devouring Woolly Aphis and other pests all the year round, and should be protected in every orchard.

Methods of Prevention and Remedy.

(1.) This blight is especially prevalent in neglected orchards, where the trees are set close together, and have their trunks and boughs covered with lichens and moss, and where rank grasses grow below. These points should all receive attention and be remedied at once. Till now, in order to remove lichens and mosses, and destroy hibernating insects, a caustic alkali wash has been recommended composed of 10 lb. of caustic soda, 10 lb. of carbonate of potash, and 100 gallons of water, to which 2 or 3 lb. of soft soap were added. Numerous records testify to the value of this wash. Recent experiments, however, conducted by Mr. Spencer Pickering at Woburn, have resulted in a more efficient Winter Wash. The directions for making 30 gallons of this soda-emulsion wash are :—

Dissolve $1\frac{1}{2}$ lb. of soft soap in 1 gallon of water by heating it; add to this gradually 2 gallons of paraffin, churning up the whole with a syringe fitted with a rose-jet, until it becomes a thick creamy emulsion; stir this emulsion into 27 gallons of water in which 6 lb. of caustic soda have previously been dissolved.

In using this wash the face, hands and clothes of the workmen must be protected. See also Leaflet No. 70 (*Winter Washing of Fruit Trees*).

(2.) Another plan likely to do good is to whitewash the trunks of the trees. Before this is done all the rough bark must be scraped off, so that a smooth surface is made to take the wash. The best "paint" to use is one made of soft soap and lime, as follows :—1 lb. of soft soap, 1 gallon of lime, and a small quantity of size, mixed with just sufficient warm water to form a thick whitewash.

(3.) In destroying this insect during the summer and when it is on the young wood, washing to be effectual should be commenced directly the first traces of the white wool appear. Ordinary soft soap and quassia wash may be used, but paraffin emulsion (See Leaflet 16) has been found best for this attack.

(4.) With regard to the attack on the roots, great care should be taken to see that all young stock is clean before planting. If any traces of the "root louse" or the aerial form are seen, the trees should be returned to the nurseryman to be disinfected before being planted. All nursery stock should be fumigated with hydrocyanic-acid gas, and thus thoroughly cleared of all insect pests before planting.

Where the root form is committing havoc, the best plan is to use bisulphide of carbon. This should be injected into the soil in four places about two feet away from the trunk of the apple tree. For each injection one fluid ounce of bisulphide of carbon is sufficient for a good sized tree. It should be injected into the soil so as not to come into actual contact with a root. The liquid would harm the root, but the vapour is harmless.

This plan works very well and should invariably be followed when any white wool or rough lumps are seen on the roots of trees that seem to be in an unhealthy state. On exposing the roots the signs of Woolly Aphis can easily be noticed and the remedy should then be applied around the trees.

It must be remembered that both hydrocyanic acid gas and bisulphide of carbon are very poisonous; and that the latter substance is highly inflammable, and should not be brought near a light—the operator should not even be smoking.

(5.) Kainit hoed in round the roots has been found efficacious in Canada.

(6.) In Australia two varieties of apples are said to be proof against the action of the Woolly Aphis by reason of their bark being hard and their tissues close, thus resisting the action of the beaks of the insects. These are the Northern Spy, an American apple, and the Majetin, a Norfolk (England) variety. Apples in Australia are now always worked upon these stocks. Mr. French, Government Entomologist of Victoria, says, "Before the advent of these excellent blight-proof stocks, the Majetin and the Northern Spy, it was exceedingly difficult to find in most orchards an apple tree that was clean or in perfect health. Now, with a little care and attention, the fruit grower, as a rule, may snap his fingers at the American Blight." Mr. T. W. Kirk, Government Entomologist of New Zealand, has also given a list of varieties that are specially resistant.

Orchardists in Great Britain might profitably pay attention to this subject, which has been much neglected here. The two varieties, Northern Spy and Majetin, do not seem to be known in this country to the majority of growers and nurserymen.

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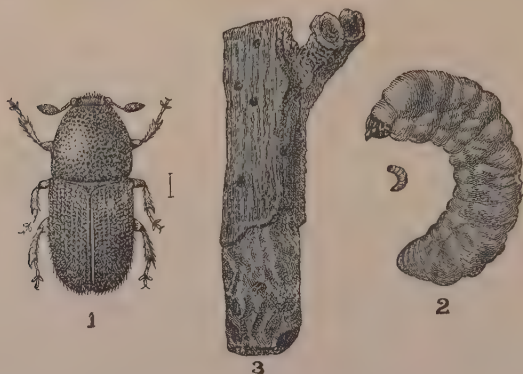
October, 1896.

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BOARD OF AGRICULTURE AND FISHERIES.

The Fruit Tree Beetle (*Scolytus rugulosus*, Ratzeburg).



1. Beetle magnified ; line showing natural length.
2. Larva, natural size, and much magnified.
3. Piece of Apple branch, showing holes in bark made by the beetle, and channels made in the wood.

There have been numerous complaints of damage to fruit trees which on investigation has proved to be due to *Scolytus rugulosus*, the adults and the larvæ of which make tunnels, typically between the wood and the bark. The main stem may be infested, as well as the thicker branches and smaller twigs. If the part attacked has thick bark then the tunnels may be more in the bark than on the wood, but thin-barked branches are commonly attacked, and in such places the tunnels are cut sharply into the outermost youngest wood. The "mother galleries" run in the longitudinal direction and the "larval galleries" are more or less at right angles to these.

Scolytus rugulosus very willingly attacks sickly trees ; the larvæ have been frequently found at work in the tips of shoots of trees injured by frost or other weather influences, as well as near knots and scars from canker or knife cuts. The beetle, however, also attacks healthy trees, and if in overwhelming numbers may kill them.

Trees attacked.—The Fruit Tree Beetle attacks apple, pear, plum, cherry, apricot, nectarine, peach, quince, bird-cherry, hawthorn, and mountain ash.

Signs of Infestation.—External signs of infestation are, the withering and dying of the leaves, exudation of gum from such trees as cherry and plum, the dying away of the ends of twigs and smaller branches, loosening of the bark, the tiny entrance holes which may be obscured by exuded sap, and later the flight holes in the bark through which the new adults have issued.

Description of Insects.

The beetle, which measures one-tenth of an inch in length, is slightly shiny, and pitch-black in colour, the antennae, shanks, feet, and the ends of the wing-covers being reddish brown. The thorax, which is longer than broad, is somewhat narrowed in front and is thickly beset with deep punctures which run together, especially in front and at the sides, and give a wrinkled or puckered appearance. The wing-covers, narrowed behind, are striated and finely puckered, and bear small bristles. The abdomen is arched and slopes from the lower surface, at the hind end.

The larva is a white legless grub, with a wrinkled body, yellowish head, and brown mandibles; the front part of the body is thicker than the hind part.

The pupa is white.

Life History.

The adult beetles bore into the bark, and the female tunnels a gallery in the longitudinal direction, laying eggs right and left, and close together, as she goes along. The length of this "mother gallery" varies from half-an-inch to just over an inch. The larvæ on hatching eat out galleries more or less at right angles to the mother gallery; the regularity of the larval galleries varies according to the number of larvæ present, irregularity being more pronounced if the larvæ are overcrowded. Where there is room, and the branch attacked is thick enough, the larval galleries are regular: only at the top and bottom of the mother gallery the larval galleries bend round to run somewhat in the longitudinal direction. When full grown the larva gnaws out a bed, typically in the outermost wood, and here pupation takes place.

There may be such overlapping in the generations that all stages—larva, pupa, and adult—may be found at the same time. The earliest beetles begin working towards the end of April and in May, and a brood from the eggs laid by these may begin to issue towards the end of June. From the earliest laid eggs of the June beetles new adults may appear in the autumn.

Treatment.

1.—Pruned branches should not be left in heaps to act as centres for breeding.

2.—Infested branches should be cut off and burned by the beginning of June before the new brood has escaped. Badly infested trees should be cut down and burned.

3.—In orchards, plantations, and gardens where there is considerable infestation, worthless trees that are unfruitful or decaying could be ringed and allowed to stand as traps; beetles would choose these for their egg-laying, and the trap trees should be cut down and burned with the enclosed brood.

4.—In the literature referring to *S. destructor* it is recommended that the trees should have applied to them dressings which would deter the beetles from boring. As, however, the thinner branches are attacked by this beetle the whole tree would need to be so treated, and where the trees are numerous such treatment would be scarcely practicable. Soft soap with the addition of a strong solution of washing soda has been recommended for the purpose, the coating of this material on drying being a preventative against the boring of the beetles; lime-sulphur in spring has been recommended for the same purpose.

The beetle is destructive to fruit trees in the United States and several European countries. In the United States several parasites (*Chalcididae*) help to keep the beetle in check; one of these has been identified as *Chiropachys colon* and another was probably *Pteromalus maculatus*. From some Scolytus larvæ sent to the Board of Agriculture and kept in suitable conditions, at least two species of *Chalcididae* appeared.

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June, 1898.

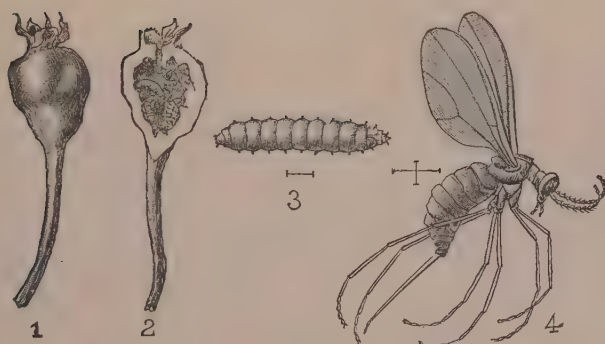
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BOARD OF AGRICULTURE AND FISHERIES.

The Pear Midge.

(*Diplosis pyrivora*.)



1. Pear stunted and malformed by the larvæ within it. 2. Section pear with larvæ. 3. Larva, much magnified. 4. Female fly, much magnified. Lines show natural length of fly and larva.

The pear midge causes serious losses in pear orchards by its attacks on the young fruit. Some pear growers, seeing the young pears falling fast in June when they are about the size of marbles, used to believe that this result was due to an unhealthy condition of the tree, or to influences of the weather, but they now recognise that it is more often due to the insidious attack of the tiny pear midge, the presence of which is far more common than is usually believed.

It would appear that early pears, and those that blossom early, are most liable to infestation by this insect. Williams' Bon Chrétien is notoriously subject to it, and in America, where the pear midge is very prevalent and most destructive, the Bartlett pear (identical with Williams' Bon Chrétien) and the Lawrence are the varieties chiefly attacked. Beurré de l'Assomption, earlier than Williams' Bon Chrétien, is also frequently seriously affected. Pitmaston Duchesse, Marie Louise, Jargonelle, Souvenir du Congrès, all early,

and like the Bon Chrétien in many respects, are also especially liable to be infested. Infestation has been noticed on later pears, as Josephine de Malines and Catillac, but in a much less degree than on earlier varieties.

Professor Riley, writing in 1885, considered that the insect had been imported from Europe, as until it was found in 1880 upon a certain farm near Meriden, in Connecticut, no insect of similar habits was found in the United States.

This is probably the same insect as that termed *Cecidomyia nigra* by Meigen. Schmidberger first described the habits of this insect in 1831. He says: "The species of gall-midges found by me in the pears are evidently the *Cecidomyia nigra*, because the description which Meigen gives of the black gall-midge completely agrees with this. I retain Meigen's name, and call it the black gall-midge." Riley, however, suggested that the name of *Diplosis pyrivora* would be suitable, and this has been adopted by entomologists, as it is not certain that Meigen's species is the same.

It is not known how long the pear midge has been at work in this country. It was first mentioned more than twenty-five years ago, and there is every reason to believe that it had been present here long before this, for its action upon pears, closely resembling, as it does, that of weather and other natural causes, might easily have been mistaken for these, especially as there were then comparatively few trained observers. It is certainly on the increase in many parts of the country, causing a heavy annual loss, and unless checked will cripple the cultivation of this fruit.

Description.

The fly is nearly one-tenth of an inch long, with an expanse of wings of nearly one-fifth of an inch. Its slender body is blackish-grey to black in colour, with pale yellowish and white hairs; its antennæ, with twenty-six joints in the male, are dark brown and very long; its legs are also very long, and yellowish brown. The wings are grey with dusky hairs, and a few dull yellowish ones at the base. The female is slightly longer than the male, having antennæ with fourteen joints, and an exceedingly long ovipositor for the purpose of depositing her eggs in the calyces of the blossoms of the pears. In colour the female is dusky grey, always paler than the male.

The larvæ are footless, yellowish-white in colour, and are composed of fourteen segments, with a brown head, bearing two nipple-like, two-jointed antennæ; on the underside near the head end is a long brown process slightly furcate at the tip—the anchor process or breast bone. When mature the larvæ reach one-seventh to one-sixth of an inch in length.

The pupa is about one-tenth of an inch in length, black above, and yellowish-brown beneath.

The eggs are longish, and transparent white, a number being laid in a single flower.

Life History.

The perfect midge appears in April, about the time the blossoms commence to show signs of the white petals, and continues on the wing until about the second week in May. The exact time varies from year to year and in different localities to some slight extent. The females lay their eggs both in the unopened and the expanded blossoms by means of the long egg-laying tube. When the blossom is unopened they pierce the petals and deposit the eggs on the anthers, usually in little heaps. When the blossoms are expanded they push the egg-tube deep into the pistil or ovary. In from four to six days the eggs hatch and the young maggots make their way into the developing fruit. By the first week in June some of the maggots are fully grown and commence to leave the fruit; the majority may be mature by the end of the second week, or towards the end of June the pears may still contain the maggots. Some are however unable to escape owing to the pears not splitting or decaying so rapidly, and thus remain on the trees longer. The majority of the maggots leave the pears, either by a cleft on the fruit or by some decayed patch. The fruit may or may not fall with the maggots in it; as a rule the larvæ escape when the pears are on the trees, but some correspondents mention the ground being covered with small fruit laden with midge larvæ. The maggots, in common with others of the genus *Diplosis*, have the power of skipping. When they leave the fruit on the trees they move to the outer surface, bend their bodies and make a spring on to the ground. At times this jumping habit is very marked. As many as forty larvæ have been counted in a single pear, but fifteen to twenty seems to be about the normal number. In some pears picked at random from infested material the following numbers were found:—16, 21, 28, 15, 19, 15, 17, 23. On reaching the ground the larvæ bury themselves under the soil, usually about an inch and a-half from the surface. Professor Lintner observed them to go as deep as two and a-half inches in America. At the end of about two weeks they have completed little papery cocoons of a dirty creamy silk, which become more or less covered with fine grains of earth. The cocoons are one-tenth of an inch long. Many of the maggots may remain as such until the end of winter and pupate in the early spring; others seem to pupate in a few weeks after entering the soil. If the larvæ cannot escape from the pear, as sometimes happens, they remain in it (as larvæ) for some time, until it decays on the ground.

When the larvæ first attack the fruitlets their presence cannot be detected ; later they form small dark tunnels, and by degrees they hollow out all the pear, which becomes internally a blackened mass of pulp and excreta.

Appearance of Infested Fruit.

About two weeks after the attack has commenced the fruitlets begin to swell abnormally. The diseased fruit always grows much more rapidly than the sound. By degrees the fruitlets become deformed, some rounded, others bulged out at the sides and much distorted. On cutting them open they will be found to contain the larvæ. Internal examination should always be made, as sometimes pears become deformed from other causes.

Preventive Measures.

1.—In gardens the best remedy is hand-picking where dwarf trees are attacked, but in large orchards this is not possible.

2.—Mr. Fletcher, entomologist to the Canadian Government, suggested that when trees are persistently badly attacked and the fruit not likely to come to maturity, a heavy spraying with arsenites or sulphate of copper should be given so as to kill the fruit ; the larvæ would thus all be starved to death by having their food destroyed.

3.—Skimming off two inches of the surface soil beneath the trees in winter and burning it, replacing it afterwards as is done in gooseberry sawfly attack, would be sure to do good, but on a large scale probably could not be carried out. Certainly it is advisable to cultivate the ground beneath the trees, instead of having the land under grass.

4.—At present no detailed experiments have been carried out with spraying, but it is possible that by spraying with paraffin emulsion as soon as the blossoms show the first white petals, and at the same time giving the ground a good drenching with the emulsion beneath the trees, the pest might be deterred from egg laying and many killed in the soil. This would have to be done at the time when the flies are appearing from the soil. The emulsion for the ground should of course be stronger than that applied to the tree.

5.—The use of kainit has proved serviceable in America. Dr. Smith, who has made careful experiments with the pear midge, has found that kainit spread under the trees has been most effectual in killing the larvæ. He recommends that the ground under the trees should be dressed with kainit at the rate of a ton to the acre and mentions an instance of an orchard so treated having practically escaped infestation, while in an adjoining orchard not treated he failed to find a single fruitlet not containing larvæ. In New Brunswick

kainit has also been used with success in orchards at the rate of half a ton to the acre. In Great Britain some experiments (Journal S.E. Agri. Coll., No. 7., p. 27) have shown that kainit at the rate of 5 cwt. to the acre killed the larvæ if applied just about the time the larvæ fall from the fruit, though a Herefordshire grower who employed this method in his orchards got negative results. It is certainly advisable for growers to give kainit a fair trial at the rate of half a ton to the acre, a quantity that may be safely used, where the orchards are down with grass or not cultivated with strawberries or vegetables. To be successful the kainit must be spread very evenly, and be applied just before or when the larvæ are falling, as it has the greatest effect on the larvæ before they become enshrouded in their silken cocoons.

6.—Gas lime has been used but is not successful; its coarse nature enables many of the grubs to escape its effects, but possibly, if finely powdered and spread evenly, it might have a similar effect to kainit.

4, Whitehall Place, S.W.

October, 1898.

Revised, July, 1905.

The Board of Agriculture and Fisheries would be glad if recipients of this leaflet would make it known to others interested in the subject. Copies may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

The Pear and Cherry Sawfly.

(*Eriocampa limacina*, Cameron.)



Slugworms (Larvæ of *Eriocampa limacina*) upon a leaf.

The extremely repulsive larva of this sawfly is frequently most destructive to pear and cherry trees. It also infests apple, plum, damson and peach trees, and is occasionally seen upon oak, birch, and other forest trees, as well as on some species of thorns. In the dry seasons of 1899 and 1901, cases occurred where nearly all the leaves fell from pear trees in consequence of the continuous attacks of larvæ of this insect. The larvæ are sometimes termed "slugworms" or "snegs."

The adult sawfly is harmless—although by it the eggs are laid—but the larva or slugworm eats away the upper epidermis of the leaf and destroys the soft tissue or parenchyma between the veins; the veins and the lower epidermis are left intact. To begin with, the leaf is eaten in patches here and there, but ultimately every particle of green is devoured. Severe infestation entirely prevents the production of fruit and even a slight attack has a marked effect on the crop of pears, which cannot come to perfection if the foliage is injured.

This insect does much harm to pear and cherry trees in America. As early as 1797, according to Harris, the larvæ caused great injury. "Small trees," he says, "were covered

with them, and their foliage entirely destroyed, and even the air, by passing through the trees, became charged with a disagreeable and sickening odour given out by these slimy creatures." This has also been noticed in England. In California the pest is often very troublesome, especially to pear trees. Professor Saunders states that in 1874 *Eriocampa limacina* was unusually abundant in Ontario, in many cases destroying the foliage so thoroughly that the trees looked as if they had been scorched by fire. This insect was at one time called *Selandria cerasi* in America. It is also well known in France and Germany.

Description.

Sawfly.—The adult sawfly is not quite a quarter of an inch in length, and has a wing expanse of about half an inch. Its body is blackish; its wings are dusky, with traces of a dark band across them, but they are slightly paler at the tip; its legs are also dark.

Larva.—The larva is at first white, but in a day or two it becomes green, and soon afterwards a dark green slime exudes from and covers its body. This exudation is evidently designed to protect the insect from parasites, and from the influences of the weather, to which it is fully exposed upon the upper surface of the leaf. The larva is particularly ugly at this period of its life, being slimy and dark green or almost black, the under part of the body paler; while its head and the upper part of its body are much broader than the lower part, which tapers towards the end. At this stage it very much resembles a malformed slug or a tadpole. It has seven pairs of "sucker" feet on its abdomen, three pairs of distinct feet upon the thorax, and a pair of very rudimentary "sucker" feet at the end of its body. But with all these feet it moves very slowly, being slug-like in its movements. When it is full grown it is close upon half an inch in length, and at about the end of a month, after five moults or castings of skin, it loses its slug-like appearance and slime, and assumes an orange yellow or buff colour.

Life History.

The adults usually make their appearance early in June, but sometimes in May. The female soon proceeds to make an irregular oval slit in the leaf with the aid of her peculiar saw-like apparatus, which resembles that of the gooseberry sawfly (*Nematus ribesii*) and many other sawflies. In this abrasion an egg is deposited; this can be easily seen on the leaf, as a slight, round spot is formed, in the centre of which there is a transparent skin or film covering the whitish egg. The number of eggs upon one leaf often amounts to twenty or even more, but as a rule

not more than five or six larvæ, usually only one, are seen upon a leaf. The egg is always laid from the under surface of the leaf.

The larva hatches out in from seven to twelve days, and emerges from the upper surface of the leaf. It feeds voraciously, and when full grown crawls down the tree, or falls to the ground, where it develops into a dark-coloured pupa in a little cell made of silk and earth. There are two or more broods during the year. The pupal stage lasts two weeks during the summer. The winter is passed in the larval stage in a case of earth beneath the trees, the grub pupating in the spring. The larvæ are found upon the leaves of fruit trees even as late as October.

Preventive and Remedial Measures.

1.—As it is clear that the pupæ of this sawfly are in the earth immediately under the fruit trees upon which the larvæ have been feeding, it is desirable to dig the ground all round the trees in the early spring, and to hoe it with pronged hoes so that the earth may be broken up finely. Quicklime should then be put on and hoed in.

2.—In gardens, after the digging and hoeing, it would be useful to beat down the earth in the spring with a shovel in order to prevent the flies from coming up.

3.—Soot and lime should be scattered evenly and in moderate quantity under the trees in autumn, as it has an injurious effect upon the larvæ when they fall to the ground.

4.—In the late autumn or winter poultry might be penned round trees that have been severely attacked in gardens and orchards.

5.—The removal and burning in winter of the surface soil below such trees has been proved a useful measure.

6.—Paris Green has been used as a remedy for these slug-worms. It poisons their food, and is used extensively in the United States for attacks of the sawfly larvæ and many other insects. It should be obtained in the form of paste and be applied in the proportion of 1 lb. of Paris Green to 200 gallons of water, carefully mixed and distributed over the leaves as evenly as possible. The paste can be much more easily mixed with water than the powder, which is so fine that the least breath of air blows it over the face and clothes of those who use it.

7.—Other useful insecticides are hellebore wash and arsenate of lead. These are employed as follows:—

(a) Hellebore wash.—1 oz. of fresh hellebore, 3 gallons of water, 2 ozs. of flour. This must be constantly stirred.

- (b) Arsenate of lead.—This should be obtained in the paste form, the proportion recommended for use being 2 lb. to 50 gallons of water or two even teaspoonfuls to a gallon of water, the whole being thoroughly mixed.

These washes are poisonous, so must not be used on ripe or ripening fruit for four weeks before it is gathered.

These remedies would be applicable to pear, apple, plum, and damson trees. It would be more difficult to apply them to cherry trees, as the fruit is often nearly ripe when the attack of the insect is first noted. After the cherries are picked the trees should be dressed to prevent the larvæ from devouring the foliage and weakening the trees for the next season.

Heat and drought are, without doubt, favourable to the multiplication and destructive activity of this insect, while cool, showery weather interferes not only with the hatching of the eggs, but also with the growth and health of the larvæ. It is generally found that the larvæ do not cause serious harm in wet seasons.

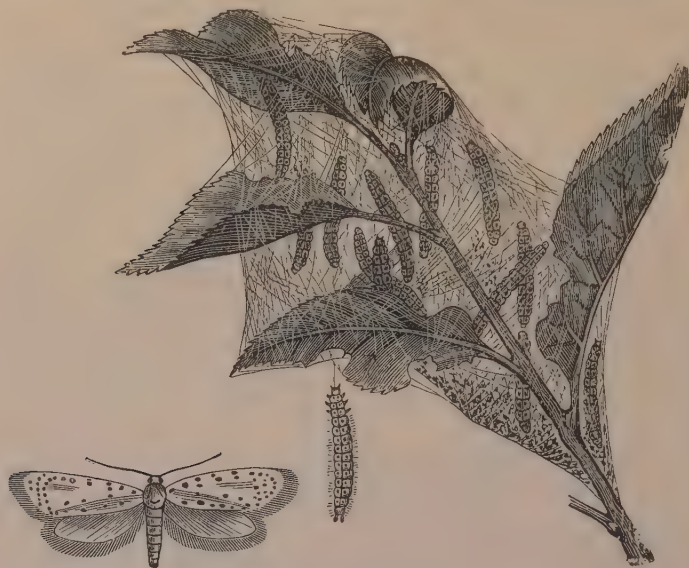
4, Whitehall Place, S.W.
January, 1900.

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BOARD OF AGRICULTURE AND FISHERIES.

The Small Ermine Moths (Genus *Hyponomeuta*).



H. padella, L.

Moth, twice natural size; larvæ and web about natural size.

Identification.

The genus *Hyponomeuta* belongs to the *Tineina*, a group of small moths. The genus, though containing a small number of species, is widely distributed. There is considerable confusion in the literature, in the description, and in the naming; the confusion arises from the fact that (1) both the moths and caterpillars of the different species have a great resemblance to one another; (2) the caterpillars of more than one species may be found on the same food plants; and (3) the separate life histories are very much alike.

Generally it may be said that the moths are small, their fore wings are white or lead-grey or slate-coloured, with black dots (hence the name Ermine Moths); and the thorax has usually also similar marks. The hind wings are darker in colour and have long fringes. The caterpillars live together socially on the twigs in gauze-like spun webs, and under cover of these webs pupation takes place in cocoons shaped like oat grains.

The caterpillars of two or three species are destructive to the foliage of the Spindle tree (*Euonymus europæus*, L.), and in addition in Britain there are three species harmful to fruit trees, viz., *Hyponomeuta padi*, Zell. (*H. euonymella*, L.), whose caterpillars feed chiefly on bird cherry; *Hyponomeuta padella*, L. (*H. variabilis*, Zell.), whose caterpillars feed on plum, hawthorn, sloe, medlar, apple, mountain-ash and other *Pyrus* species; and *Hyponomeuta malinella*, Zell., whose caterpillars feed on the apple.

H. padi. This moth is the largest of the three. It measures 9 mm. in length (roughly, there are 25 millimetres in an inch) and 25 mm. in stretch of wings. The head is white, and the upper surface of the fore wings is also white with five longitudinal rows of black dots. The hind wings are dark grey. The caterpillars are yellowish in colour, with black heads, and may measure when full grown 20 mm.

H. padella measures 8 mm. in length, and 22 mm. in stretch of wings. Head white; fore wings white-grey with four longitudinal rows of black dots, a small number in the lowest row; hind wings dark grey with pale grey white-tipped fringes; the abdomen ash-grey with whitish rings. The caterpillars have black heads, they are greyish in colour with conspicuous dark-coloured spots, and measure 14 mm. in length. The pupa is yellow in the middle, the head and wing-cases are black-brown, and the cocoons, which hang singly in the web, are very delicate.

H. malinella is 7 mm. long, and 17 mm. to 19 mm. in spread of fore wings. The fore wings have four longitudinal rows of black dots; the hind wings are dark grey with the fringes pale grey. The caterpillars have black heads and are yellowish in colour, with slight variations at different ages. The cocoons are not delicate as in *H. padella*, but they are opaque and hang together in bundles.

Life-History.

The moths are found flying in July and August, and the eggs are then laid on twig and bud in larger or smaller collections. The eggs lie under cover of a glutinous substance which dries into a protecting case. They may hatch in the autumn of the same year, but the caterpillars, on account of their small size, are not noticed. They do no damage until the next spring when they may enter buds, feeding on the blossom and mining into young leaves. Soon attaining strength, in May and June the caterpillars feed externally on the leaves and spin their webs. The web-making continues as the larvæ move to fresh feeding places. The feeding caterpillars are social, living together in numbers in a web or nest.

In cases of bad attacks the trees may be almost stripped of foliage, and rendered unsightly by the dirty coloured ragged

webs. The caterpillars when full-fed become pupæ in cocoons, a number of these being present in a web; the pupal stage lasts a fortnight.

Infested trees are greatly weakened by the loss of foliage, and although after the caterpillars have stopped feeding the trees produce a fresh set of leaves, there is bound to be shortage of the fruit crop. In the case of the apple the young fruits fall away when the foliage is stripped.

Preventive and Remedial Measures.

1. The moths may be shaken down from the trees on which they rest during the day, on to cloths spread below to catch them. The moths are sluggish and rest with their narrow wings rolled round the body.

2. Handpicking (if practicable) and cutting off of infested twigs should be practised, the webs being crushed or burnt in order to kill the contained brood.

3. If water under high pressure from a hose can be applied the colonies may be effectively destroyed.

4. Spraying with paraffin emulsion, or an arsenical spray. The earlier this is done the better, before the webs become so numerous or so thick as to protect the leaves from the wash and prove difficult to penetrate. The Board know of one case in Perthshire where, in an extremely severe infestation, the proprietor, dissatisfied with the result of a paraffin spray, made up a strong solution of an arsenical sheep dip, and by this means killed thousands of caterpillars. The caterpillars that had not been killed, or which on disturbance had let themselves down from the web by their threads, collected at the foot of the trees and were easily destroyed. Great care, however, had to be exercised, as any leaves touched by the material turned black and dropped off.

4, Whitehall Place, London, S.W.

August, 1900.

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BOARD OF AGRICULTURE AND FISHERIES.

 Currant Aphides.

Now and again currant bushes are considerably damaged by Aphides or Plant Lice. In some districts the bushes are quite ruined, the leaves turn brown and shrivel up, and the fruit falls off, the bunches "shanking" in consequence of the abnormal presence of these pests. The rapid increase of the "Plant Lice" is due to a long spell of dry, warm weather, so favourable to the development of these insects, so detrimental to the development of the fruit and health of the bushes. Aphides are usually more or less prevalent on currants, and are always liable under certain favouring climatic conditions to increase to an injurious extent. Currant bushes should therefore be washed early in the year just as regularly as apple, plum, and pear trees. Of species of Aphides occurring on the genus *Ribes*, there may be mentioned the Currant Blister Aphis (*Rhopalosiphum ribis* of Linnæus), *Myzus ribis* of Linnæus, and the Currant Root Aphis, *Schizoneura fodiens*, Buckton.

LEAF APHIDES.

The first two aphides live above ground and work in a slightly different way. One, *R. ribis*, produces reddish, reddish-brown, or yellow blister-like galls on the surface of the leaves, whilst *Myzus ribis* often causes the leaves to curl up, especially on the top shoots. Both species are equally difficult to destroy after they commence to breed in numbers, owing to their being hidden, and more or less protected in the hollows of the blisters and under the curled-up leaves. The galled patches are chiefly noticed on the upper surface of the leaf, where they are blister-like; below they are concave. In the cavity the Aphides live and breed, increasing the area of the diseased patch as they develop. Numerous blisters may be formed on one leaf, varying in size from one-fourth to nearly an inch in length. The leaves so attacked shrivel away, but the fruit often falls, owing to loss of sap, long before the leaves die. Neither of these Aphides is said to form much "honey-dew," hence the diseased appearance of the leaf is often not noticed as being of insect origin during the early stages of the attack unless an examination has been made of the under surface. Later on "honey-dew" becomes abundant, being

especially formed by the leaf-curling species; on black currants the "honey-dew" often gives a shiny and sticky appearance to the whole bush.

The insects spread chiefly by means of winged generations, which appear every now and then, flying from bush to bush, and there setting up fresh areas of disease. These winged generations may occur as early as the middle of May, but usually not until June.

Life-history.

The appearance and habits of *R. ribis* and *M. ribis* are different, but their life-histories are very similar.

(I.) *Rhopalosiphum ribis*, L.—The wingless viviparous female, or "Mother Queen," is shiny green, mottled with darker green; legs, honey-tubes, and antennæ pale green; eyes, red. In form it is oval and convex, and slightly larger than *Myzus ribis* (II. below), the body being one-tenth of an inch long. The wingless females are found on the under-surface of the leaves and cause the red, orange, and yellow blisters. They appear first of all in April, and occur continuously until July and even August. Every now and then the lice to which they give rise turn into so-called pupæ which are characterised by rudiments of wings appearing as wing buds.

The pupa is green, and does not, apart from the wing cases, differ much from the wingless female or larva. The winged viviparous female, which arises from the pupa, is yellowish-green with black head and antennæ; the thorax is black with a yellow band in front; the abdomen is bright yellowish green, with dark spots and patches on the back and sides; yellow honey-tubes, swollen towards the apex; legs ochreous, with the joints and the feet black. These winged females fly from bush to bush. In the autumn or late summer males and egg-laying females are formed; the egg-laying female, after being fertilised, deposits a few brown elongated eggs on the last year's growth of a twig just under the broken rind or upon it. Here the eggs remain all the winter. This aphid, besides feeding on the red, black, and white currant, also attacks the gooseberry, and has been found on the Guelder Rose, Nipple Wort, and Sow Thistle.

(II.) *Myzus ribis*, Linn.—This plant-louse can easily be distinguished from the former, with a lens, by its olive, not black, head, and its black honey-tubes and irregularly black ornamented abdomen in the winged female. It occurs from April to August, especially on the black currant and gooseberry, but also on the red currant; it is said to cause blisters similar to *R. ribis*. It often causes the leaves at the apex of the shoots to curl and twist up.

The wingless female, which appears in the spring, is shiny yellowish-green, with dark green mottlings, elongated oval in form, and with curious hairs in front; the honey-tubes and legs are pale green, and the eyes bright red. The larvæ are pale green. When the leaves lose their sap, the larvæ turn to pupæ, and then to winged females. The pupa of this species is shiny yellowish-green, with two brown spots on the back of the head. The winged viviparous female is bright green, with pale olive head, brown thorax with an olive band across it, irregular transverse bands and spots on the abdomen, and four or five dark lateral spots; the deep olive-green to black honey-tubes are cylindrical in form, and the deep green legs have olive feet. Towards July many leave the currants, but as in the former species some always remain, and give rise to egg-laying females and males, the former depositing their long brown eggs under the exfoliated rind, attaching them to it by a gummy excretion; the eggs hatch in the spring, when they give rise to larvæ, which soon grow into the "Mother Queens." The wingless female is smaller than in the former species, being little more than one-twelfth of an inch long. It also occurs on the gooseberry, and it has been noticed to curl up the leaves and deform the shoots more often than the former species.

Natural Enemies.—The larvæ and adults of the two-spotted Lady Bird are often to be found feeding amongst the colonies of lice, and do inestimable good in keeping them in check. Larvæ of several species of Hover Flies also feed on them, their leech-like green or dull red larvæ living amongst the lice in the blisters or curled leaves.

THE CURRANT ROOT APHIS.

(*Schizoneura fodiens*, Buckton.)

This Aphis, which infests the roots of black and red currants, is mentioned by Buckton in his Monograph, and has been recently recorded by Theobald in England and Carpenter in Ireland. It is recognisable by the woolly fibrous material which covers the insect, as it does the *Schizoneura* of the apple.

Dangerous possibilities attend the spread of this insect, and Theobald recommends the examination of young stock before planting. Where the woolly material is observed the roots of the plants should be dipped in a warm mixture of soft soap, quassia, and water.

PREVENTION AND TREATMENT.

1.—After an attack black currants should be cut very hard in the autumn, the strippings being carried away and burnt. By doing this many eggs will be destroyed. Probably

some benefit would be derived by the winter washing with caustic alkali wash (*see* Leaflet 70), the bushes being sprayed about February.

2.—When Aphides are present on the bushes it is most important to *spray early in the year*, directly the lice are seen, that is before the blisters appear or the leaves become curled up ; the lice can then be far more readily reached by the spray than later in the year.

Various sprays which are of service against Aphides, and treatment against root infesting forms, are mentioned in the Leaflet on Aphides, No. 104.

3.—The development of plant lice is favoured by dry and hot weather, and swilling with ordinary water is always beneficial in such conditions.

4. Whitehall Place, London, S.W. ,
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BOARD OF AGRICULTURE AND FISHERIES.

TENT CATERPILLARS.

The Lackey Moth (*Clisiocampa neustria*, Linn.) and the Brown Tail Moth (*Porthesia chrysorrhæa*, Linn.).

Two species of so-called "Tent Caterpillars" are frequently found on various fruit trees, especially on the apple, plum, and pear. By far the commonest and most destructive of the "Tent Caterpillars" is the Lackey Moth Caterpillar (*Clisiocampa neustria*). In some parts of England, however, notably certain districts in Kent, the somewhat local Brown-Tail Moth (*Portnesia chrysorrhæa*) does almost as much harm in some seasons. In parts of Kent the caterpillars have in some years done considerable damage to apple and plum orchards. The caterpillars of both moths are called "Tent Caterpillars" on account of their forming tent-like nests of silk on the trees, in which they live during their early existence, and beneath which they shelter during wet weather and at night when they are more mature.

The damage caused by the larvæ can easily be prevented, and even when they have a considerable hold on the orchard they can be dealt with and to some extent be destroyed by spraying.

As there is some difference in life-history as well as in appearance between the two species, they are best considered separately as far as their natural history goes; prevention and treatment are the same for both species.

I.—The Lackey Moth.

Distribution, and Trees attacked.—The Lackey Moth is widely distributed over the south, west, and middle of England, but is far more abundant and destructive in the south and west than in other parts. It does not occur further north than York, where it is usually rare. Always more or less prevalent in the south, at certain times it occurs in greater abundance, and apple and pear orchards are sometimes stripped of every vestige of foliage by the caterpillars. It is abundant in France, where there are laws compelling growers to cut off and destroy the "tents" formed by the larvæ. The "Lackey" larvæ feed also on oak, elm, hawthorn, and many other trees and shrubs.

Description.

The moth is very variable in colour and size, and measures up to an inch and a quarter in expanse of wings in the male, and an inch and a half in the female. The fore wings are a rusty reddish-brown, yellowish-brown, ochreous or brick-dust red, with two pale or dusky-brown transverse lines across them, the space between the two bars being often more deeply coloured than the rest of the wing; the hind wings are the same tint as the fore, but often a little paler; the thorax and abdomen are densely scaly. The adult may be taken on the wing at dusk in July and August, and even as late as September.

The eggs are deposited in autumn in rings that surround the smaller shoots of the fruit trees, each ring containing from forty to over two hundred eggs. These remain unhatched on the trees all the winter, and, being greyish-brown in colour, are readily seen by a careful observer on the dark ground-colour of the twigs.

The caterpillars are almost black at first, and more or less hairy.

They become brilliantly-coloured as they grow, being bluish-grey, with two black spots on the segment next the head, and two also on the bluish-grey head; there are three orange-red stripes along each side, and between the two lowest of these is a broad blue stripe with little black specks, these brilliant lines being separated by black and black spotted with blue, and a white stripe down the back with a narrow black line on each side; the whole larva is covered with rather rusty hairs, darker above than at the sides. When full-grown the caterpillar reaches two inches in length.

Life History.

The eggs hatch about the end of April, and the young larvæ soon commence to form a fine web, enclosing a few leaves, and beneath this little tent of silk they continue to feed in communities for some time. As they grow the silken house is enlarged, until in some large colonies it may reach nearly a foot in length. At first the larvæ feed entirely under the tent, but as they grow they spread out over the trees, and eat off the leafage and blossom, returning to the web at night and in wet weather. On warm days they may often be found in batches, several lying parallel with one another, either on the outside of the tent or along the branches. They are somewhat timid, and fall to the ground on the tree being shaken, but soon crawl back to the foliage again. From the middle of June to the end of July they reach maturity, and spin a delicate loose white cocoon, the silk being mixed with a yellowish powder and numerous hairs of the larvæ. The cases are formed amongst the leaves, on the bark, amongst grass below the



THE LACKEY MOTH.

(A) Tent and caterpillars.

(B) Male moth.

(C) Egg-ring (natural size).

(D) Pupa (natural size).

trees, on walls, fences, &c.; always above ground. The larva changes in this cocoon to a dark-brown pupa, from which the moth emerges in from two to three weeks.

II.—The Brown-Tail Moth.

Distribution, and Trees attacked.—According to Stainton the Brown-Tail Moth is local, and not to be found everywhere. Where it does occur, however, it is often very abundant. It is recorded from Lytham, Epping, Teignmouth, Lewes, Lymington, Stowmarket, Black Park, Chesham, Dorking, Newhaven, Bisterne, Bristol, Norwich, and many other places; it has also been recorded from Scotland; it is always more or less abundant in various parts of Kent; in 1907 it was sent to the Board from Cheshire, and in 1908 from Burnham-on-Crouch.

The female lays her eggs on the under surface of the leaves of the oak, elm, beech, willow, rowan, black-thorn, white-thorn, apple, plum, and sometimes pear.

Description.

The female moth has pure white forewings, with a faint black spot; hind wings pure white. *The male* has similar fore and hind wings, white head, thorax and abdomen, the apex of the latter having a golden brown tuft. In length the wing expanse varies between an inch and a quarter and an inch and three quarters. The moth is a night flyer, resting during the day on walls, leaves, lamps, &c., and is then very sluggish, falling down as if dead when its resting place is shaken.

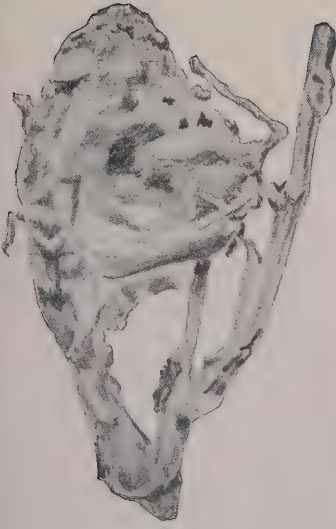
The eggs are round, of a golden hue, and as many as two hundred and fifty may be counted in each batch. Each patch of eggs is covered over by hair from the female's tail and completely hidden.

The caterpillars are at first very small, of a dirty yellow appearance, with a black head and four rows of black dots and numerous hairs. In the spring of the next year they moult and assume a deep brown appearance with reddish-brown hairs, a row of white spots on each side, a narrow double broken line of red alone on the dorsum, black between, and with two prominent bright red tubercles on the back of the eleventh and twelfth segments, depressed in the centre; these tubercles can be elevated or depressed by the larvæ at will.

The pupæ are deep brown in colour, and are enclosed in a dusky cocoon.

Life History.

The moth appears towards the end of July and in August, and eggs are laid on the under surface of the leaves. The larvæ hatch out about the beginning of August, and live through the winter. To begin with they attach a single leaf



D



C



B



A

THE BROWN TAIL MOTH.

(A) Male moth.

(B) Female moth.

(C) Summer tent and larvæ.

(D) Winter tent of larvæ.

by silk to the twig so that it cannot fall off, and eat the epidermis.

Towards September they commence to make a regular tent or nest, attaching a number of leaves together by silk. The leaves are lined and covered with silk, and all firmly united. This nest is used as a place of protection from cold and damp, and as a nocturnal shelter. During the latter part of August the larvæ moult and still feed on as long as the leaves contain any sap. Even after the leaves have fallen it is not unusual to see the larvæ on a sunny warm day basking in the sun outside the tent. As the weather becomes cold, they become dormant and remain in their dwelling. In the spring of the next year they recommence feeding on the leaves as they open, and wander freely over the trees. Very frequently the colony divides, two nests being made, and sometimes even a third is formed. Early in May they moult again, assuming the appearance described above. After this moult they spread out over the fruit trees, forsaking their nests, and then devour the foliage very ravenously.

From the end of June to the beginning of July they spin a cocoon amongst the leaves of fruit trees, as a rule several together forming a large mass united by a dusky web. In this they change to deep brown pupæ. As many as forty have been counted on a damson tree. From these pupæ the moths hatch out in the latter part of July and August, and soon commence to lay fresh eggs on the trees.

Prevention and Treatment.

1.—After an attack of Lackey Moths the orchards should be gone over in the winter and all egg-bands collected and burnt. On large trees this is not possible, but where it can be done, it is a rule that should always be followed.

The small tents of the Brown Tail should also be looked for during the winter and cut off and burnt. Any tents left should also be collected and destroyed in the early summer either on a dull wet day or during the evening, when the caterpillars are at home, or no good would be done. The tents of the Lackey should also be collected during summer. As the larvæ readily fall when shaken, care should be taken to hold boards or a sheet beneath the tents which are being cut off, otherwise little good will accrue, as the fallen Lackeys soon get back to the trees.

2.—A great deal of damage will be saved by spraying as soon as the attack is noticed, especially when the tents cannot be reached by hand. For this purpose arsenical washes should be used. Of these washes the two best known are Paris Green and Arsenate of Lead. The latter is the better wash of the two, killing the larvæ and yet not damaging the foliage, as sometimes happens with Paris Green.

The Paris Green should be bought in the paste form, $\frac{1}{2}$ lb. being used for every 100 gallons of water.

The Arsenate of Lead should also be bought in the paste form, the proportion for spraying against the young caterpillars being 2 lb. to 50 gallons of water, the whole being thoroughly mixed.

In all cases proper sprayers must be used with fine nozzles, so that a dense mist of the wash is thrown on the trees.

Natural Enemies.—Both the eggs and the larvæ of the Brown-Tail Moth are attacked by Ichneumons.

Being hairy, these larvæ are avoided by birds, so that little help is given by the latter when the pests are causing harm in the orchard. The cuckoo is the only bird known to devour these hairy caterpillars. Two beetles destroy the larvæ of the Lackey Moth on the Continent, namely, *Calosoma sycophanta* and *C. inquisitor*.

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BOARD OF AGRICULTURE AND FISHERIES.

Winter Washing of Fruit Trees.

A neglected orchard not only harbours, during the winter, all manner of insect enemies which come out in spring and commence their ravages in that particular orchard, but it forms a nursery or breeding ground from which other orchards are supplied with noxious insects. It is desirable, therefore, that all such orchards should be treated in some way to stop the damage that is caused by the various insect pests they encourage, and for this purpose winter washing is practised.

The caustic or burning wash applied clears away moss or lichen and other vegetable growths that may not only be directly harmful to the health of the tree but may also act as shelter places for injurious insects, while at the same time the wash may reach the insects themselves in their various stages of development. The Woolly Aphis, the Apple Blossom Weevil, the Earwig, the caterpillar of the Codling Moth, Thrips, and numerous other small insects are found during the winter beneath the vegetal growths and rough bark on fruit trees. The destruction of their winter quarters places these troublesome pests at a disadvantage, and their number is in consequence materially reduced.

Scale insects also, like the Apple Mussel Scale and the Brown Currant Scale, may be destroyed by winter washing.

It has been found in practice that a wash used with effect against an insect in its adult, larval, or pupal stages, may prove ineffective against the eggs of such insects as certain moths, the Apple Sucker, Aphides, Scale insects, or Red Spider.

For some time a caustic-alkali wash has been much used, and has in many ways been found serviceable in combating insect pests. This wash consists of 1 lb. of commercial caustic soda dissolved in a little water, and 1 lb. of crude potash also dissolved in a little water, the two being added to a gallon of water in which $\frac{3}{4}$ lb. soap has been dissolved, and the whole finally brought up to 10 gallons by the addition of water. Partly, however, because of its failure against the eggs of some of the pests named above, experiments have been undertaken to discover a more efficient winter wash. As a result it has been found that the addition of paraffin emulsion renders the caustic wash much more efficient. Further, there is some reason to believe that the mixture of alkalies in the winter wash is no advantage, and that the omission of the potash does not impair the efficiency of the wash.

Preparation of the Emulsion-Soda Wash.

The materials necessary for the new caustic winter wash are :—Caustic soda (98 per cent.), paraffin, soft soap, and water.

A wash having the following formula has been used successfully at Woburn Fruit Farm :—Paraffin, 2 gallons; soft soap, $1\frac{1}{2}$ lb.; caustic soda, 6 lb.; water, 28 gallons.

In order to prepare the wash the soft soap should be dissolved in a gallon of boiling water; the paraffin should then be added and the mixture churned thoroughly until a cream-like mass results. The thoroughness of the churning is important. (This paraffin emulsion, if well made, will keep satisfactorily for a long time.)

The 6 lb. of caustic soda should next be dissolved in the remaining 27 gallons of water and then poured into the paraffin emulsion. The whole should be well mixed and used immediately.

This caustic emulsion-soda wash is recommended for application while the trees are dormant, and certainly before the buds have burst. Speaking generally, the greatest advantage would probably result from such a spray-fluid if applied about the middle of February.

NOTE :—As the wash has a burning effect on the hands, care should be exercised in employing it. Rubber gloves are sometimes used to protect the hands, but these, unless close fitting, allow the wash to run under the rubber. The face should also be protected.

It is advisable not to allow live stock in grass orchards for a week or two after spraying.

As has been mentioned above, the egg is often very resistant to insecticides. Numerous experiments are at present in progress in connection with the eggs, some of the materials used, *e.g.*, lime and salt, being intended so to cover the egg that hatching is prevented. Some of the experiments have given contradictory results, and in any case the experimental record is not yet sufficiently complete to admit of quotation.

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BOARD OF AGRICULTURE AND FISHERIES.

The Pith Moth.

Much damage may be caused to young apple, and it may be to other fruit trees, by the caterpillars of the Pith Moth, a small moth belonging to the group *Tineinæ*. The moths of the group *Tineinæ* have narrow wings bordered with long fringes, the fringing being most marked on the hind pair of wings.

The caterpillars of the Pith Moth burrow into terminal and other shoots, and buds, the fruit spurs especially suffering. Infested buds fail to develop, the leaves of tunnelled shoots flag, and the shoots wither and fall away (Fig. B). The caterpillars of another small moth, the Bud Moth, one of the *Tortricidæ*, are also troublesome on fruit trees, and their work is sometimes confused with that of the caterpillars of the Pith Moth. The Bud Moth caterpillars, however, spin the leaves together, making leaf-nests.

Description.

Moth.—The moth (Fig. A) varies in size and has a wing expanse of from $\frac{2}{3}$ to $\frac{3}{4}$ of an inch. The front wings are almost entirely black, or blackish, with white streaks and scales; the hind wings are grey and have long delicate fringes.

Larva.—The caterpillar (Fig. G) is dull reddish or flesh-brown, with the head, the first segment, and the last segment deep brown. Segments two and three show pale brown spots, while the abdominal segments have six brown bristle-bearing spots. The full-grown larva measures one-third of an inch.

Pupa.—The pupa (Fig. D) is of an ochreous hue; the head and front of the thorax and the tip of the body are mahogany red. It is cylindrical in form and measures about one-fourth of an inch long. On the under surface of the last segment but one are two blunt processes, separate and diverging outwards, and hairy at their tips (Fig. C); the eyes are black, and the wing cases and legs long, the former being pointed.

Distribution.

The distribution of the moth in our country may be given as from Lancashire southwards. Theobald has recorded it from Kent, Sussex, Surrey, Devonshire and Gloucestershire, and Carpenter has recorded it from Donnybrook, Dublin.



THE PITH MOTH.

A, Moth (magnified, line shewing natural size); B, attacked apple shoot, the upper portion shrivelling up and dying away; C, processes on pupa (magnified); D, pupa (magnified) in a shoot; E, larva (natural size) in a shoot; F and G, larvæ (magnified).

Life history.

The moths issue chiefly in July. It is believed that the eggs are laid on the leaves of the apple, and on these the caterpillars may at first feed on hatching. Before winter, the caterpillars, still very small, bore into the shoots, and pass the winter just below the outer bark, the position being marked by the presence of a small blister and a distinct round hole opening into or near the blistered area. Early in the next year, the caterpillars tunnel into the pith of the shoots and fruit spurs, and work upwards in the pith. They are full grown towards the end of June, when pupation takes place in the tunnelled shoots. After the emergence of the adult the empty pupa case may be seen projecting from the dead shoots.

Treatment.

The best treatment consists in (1) prevention by means of winter pruning, the hole in or near the blistered area showing the parts to be cut away; and (2) hand-picking and burning the attacked shoots and spurs in spring.

More than one species of moth appears to be harmful in the manner described above. The subject is at present under investigation.

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BOARD OF AGRICULTURE AND FISHERIES.

The Mussel Scale (*Mytilaspis pomorum*, Bouché).



FIG. 1.*

a. Female Mussel Scale, dorsal view ; b. The same, ventral view ;
c. Male scale.

The Mussel Scale is found chiefly on apple, but also on pear, currant, plum, and hawthorn. It has also been found abundantly on blackthorn in Devonshire. This pest, one of the most injurious scale insects existing in Great Britain, is found in North America, and also in Australia, New Zealand, and South Africa, where it has been imported on nursery stock. In this way it is also largely distributed in this country. Old trees and neglected orchards chiefly encourage the scale, but young stock suffer from its effects far more than old.

The scale insect damages the trees by sucking out the sap by means of a long, flexible mouth which it inserts into the plant tissues. It occurs not only on the trunk and boughs, but also on the leaf and fruit ; it may frequently be found on imported apples.

Description.

This "scale" is frequently taken for growths on the bark, but it is the product of a minute insect belonging to

* From "First Report on Economic Zoology" (F. V. Theobald), British Museum (Natural History).

the *Coccidæ*. The male and female insects differ in appearance and size, but the males are seldom observed.

Matured Scale.—The female scale (Fig. 1, *a* and *b*) is about one-eighth of an inch long, rounded behind, but tapering to a point at the head end. It may be straight or curved, and even much contorted. In colour it varies from deep brown to a colour approaching grey. The female scale insect is fleshy, legless, and provided with a long flexible proboscis. The male scale is much smaller than the female, and of the form shown in Fig. 1, *c*. The male scale insect is very different in appearance to the female, and is provided with two rather large wings.

The Larva.—The larva is very small, active, and six-legged. It is about one-hundredth of an inch long.

The Egg.—To the naked eye the eggs resemble small whitish dust.

The Scale.—As in all *Coccidæ*, the scale is a product formed by the insect which lives beneath it, partly by excretions from its body, and partly by the cast skins of the insect, the so-called *exuviae*.



FIG. 2.—Piece of branch infested with Mussel Scale.

Life-History.

The eggs are laid by the sedentary female under the scale. As many as 80 may be counted under a single scale, but the number varies considerably. The eggs give rise in the early

summer to the six-legged larvæ, which crawl from beneath the scales, and may be distributed from tree to tree by the wind, by birds, and by predaceous insects, such as lady-birds. In a few days they fix themselves to the plant by their short proboscis and draw away the sap; the scale then commences to form by the excretion of a few waxy threads, and gradually grows to the form shown in figure 2. During this period the larva loses its legs and becomes converted into a fleshy legless creature; the female remains feeding beneath the scale, with her proboscis inserted into the tissues of the plant. Towards the end of the summer she deposits her eggs and dies, her shrivelled skin remaining beneath the scale.

If the larva is to become a male, not only is a different scale produced (most often upon the leaves), but a totally different mature insect. The male undergoes a kind of pupal stage, and escapes from the scale as a small winged insect. The males are very rare, most of the females reproducing asexually. A single annual brood is the normal condition of things in Great Britain.

Treatment.

1.—The trunks, &c., of all trees should be kept clean, *i.e.*, free from rough bark, moss, and lichens. This can be done by washing in winter with the Woburn Wash recommended in Leaflet No. 70 (*Winter Washing of Fruit Trees*). It may be given as follows :—

Paraffin	...	...	2 gallons.
Soft Soap	...	...	1½ lb.
Caustic Soda	...	...	6 lb.
Water	...	...	28 gallons.

In order to prepare the wash the soft soap should be dissolved in a gallon of boiling water; the paraffin should then be added, and the mixture churned thoroughly until a cream-like mass results. The thoroughness of the churning is important. (This paraffin-emulsion, if well made, will keep good for a long time.) The caustic soda should next be dissolved in the remaining 27 gallons of water and then poured into the paraffin-emulsion. The whole should be well mixed and used immediately. This wash has the advantage of destroying both scales and eggs.

2.—In cases of bad infestation a certain number of scales and eggs will be likely to escape the treatment, and hence a spray of paraffin-emulsion should be applied about the middle of June. This would account for the young scales not long hatched.

3.—Fumigation with hydrocyanic acid gas (*see* Leaflet No. 188) has proved a valuable scale remedy. There is no doubt that such fumigation is effective against the mussel scale in its active stages, but unfortunately experiment shows

that, with the ordinary strength used, the eggs of this scale are not affected by such fumigation.

It has hitherto been recommended to fumigate the young stock before or soon after planting. As, however, the Mussel Scale insect is then in the egg stage, such fumigation is no longer recommended. This does not invalidate the fumigation of young stock with hydrocyanic acid gas in the case of scales, *e.g.*, the Oyster-Shell Bark Louse (*Aspidiotus Ostreaeformis*), where the stock sent out for planting has on it the scale in other than the egg stage.

Natural Enemies.

Scales have many natural enemies, but this species, like the currant scale, is not materially lessened by them in this country. Amongst the natural enemies, birds alone destroy them to any appreciable extent. The tits, and a few other birds, such as the tree-creeper and wryneck, feed upon them. Tits should always be encouraged in orchard and garden. Lady-birds and their larvæ eat scale, but none seem very partial to the Mussel Scale in Great Britain. Minute Hymenoptera (*Chalcididæ*) also live as parasites upon them, but seldom do any appreciable good. Fruit growers must wash the trees and ignore the very small amount of help given by these minute parasites.

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BOARD OF AGRICULTURE AND FISHERIES.

The Shoot and Fruit Moth of Red and Black Currants.

Incurvaria capitella, Fab.=*Tinea capitella*, Cl.



Moth and Caterpillar (both magnified).

This little moth, which is not far removed in relationship from the Raspberry Moth (*Lampronia rubiella*), is one of a section of tiny moths, the members of which show considerable variations in life-history. The caterpillars of some species feed on the outside of leaves, others mine into leaves, while others feed at various stages of their life on quite different portions of the plant they attack. The caterpillars of *Incurvaria capitella* behave in the last-mentioned way, feeding in the young stage in the currant fruits, and completing their growth in the buds and young shoots. Attacks are chiefly recorded upon Red Currant, but in 1896 Miss Ormerod chronicled an attack on the Black Currant. The presence of the pest is revealed by the flower buds failing to develop, while young shoots droop, wither, and eventually die.

Description.

Moth.—The moth measures about half an inch in length, and over half an inch in spread of fore-wings. The head is deep yellow in colour; the fore-wings dark brown with a slight purple tinge. Less than half way from the base of each fore-wing is a pale yellow band running from the hind margin to the front margin; nearer the outside border on each fore-wing are two light yellow spots. The hind-wings are purple grey, while these and the outer margins of the fore-wings are ciliated, or very finely divided.

The moth has been found in North Ireland, and in England as far north as York and Manchester.

Caterpillar.—The young caterpillar on issuing from the currant fruit previous to its hibernating or resting state is extremely small (one-twelfth of an inch); it is reddish or greenish yellow in colour and has the characteristic 16 legs of a moth caterpillar; the four pairs of abdominal or middle legs are without hooks. The grown caterpillar—found in the buds and shoots—has hooks on the abdominal legs. The head is dark and the next segment has a dark plate, and there are hairs on the head and the various segments.



Shoot tunnelled by Caterpillar to the right, and Caterpillar in bored shoot to the left.

Life-history.

We owe our knowledge of the stages from the adult moth to the appearance of the caterpillar in the shoots to Dr. A. T. Chapman. The moths may be found in May flying in the neighbourhood of the currant bushes. The females lay their whitish lemon-shaped eggs in the young currant fruit. The mode of egg-laying is interesting. The moth chooses a currant and, resting on it, inserts her long ovipositor, or egg-lying tube, into the pulp and deposits the eggs near the seeds. Dr. Chapman believes two eggs to be left behind at each penetration of the currant by the ovipositor and thus more than one caterpillar may be found in a single fruit. The caterpillars on hatching feed on the seed. After feeding for a time, the caterpillar, though still very small and far from having completed its growth, burrows out of the fruit in June or July and spins a white case which is attached to the old persistent bud-scales or to the bark. With this protection the caterpillar enters upon a resting period which lasts into the next spring, when the partly grown larva leaves its case and bores into the buds, and also tunnels the young shoots. Here it renews its feeding and in April or the beginning of May completes its growth. The full grown caterpillar now passes into the chrysalis condition, and later the moth issues from the cocoon to proceed to pairing and egg-laying.

Preventive and Remedial Measures.

1. In order to destroy the caterpillars sheltering in their cases spraying should be done in winter with the emulsion-soda wash as recommended in Leaflet No. 70 (*Winter Washing of Fruit Trees*).

In connection with this Woburn soda-emulsion wash it has been found advantageous to make the emulsion with sulphate of iron and lime rather than with soap. The formula would then be :—Sulphate of iron, $\frac{1}{2}$ lb.; lime, $\frac{1}{4}$ lb.; paraffin (solar distillate), 5 pints; caustic soda, 2 lb.; water to make 10 gallons. In order to prepare this wash the following rules should be observed :—(a) Dissolve the iron sulphate in about 9 gallons of water; (b) slake the lime in a little water and then add a little more water to make it into a “milk”; (c) run b into a through a piece of coarse sacking to keep back grit; (d) churn the paraffin into the mixture; and (e) add the caustic soda in the powdered condition just before using the wash.

2. Handpicking and burning the infested drooping shoots before the pests have escaped should be practised as a preventive against future infestation.

3. The Blue Tit has been observed feeding on the hibernating larvae. For an account of the Blue Tit see Leaflet No. 43 (*Titniece*).

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BOARD OF AGRICULTURE AND FISHERIES.

The Vapourer Moth (*Orgyia antiqua*).



Caterpillar on Leaf ; winged male, top right-hand corner ;
and female moth on cocoon, surrounded by eggs.

The caterpillars of this moth are harmful to forest trees, fruit trees, garden plants, and even to pot plants, and in some seasons are very destructive. The food plants are very numerous, and embrace pear, plum, apricot, sloe, hawthorn, apple, strawberry, mountain ash, roses, bilberry, laurel, mahonia, elm, willow, poplar, birch, alder, hazel, hornbeam, beech, oak, ash, lime, while there are records of severe infestation on pine and spruce. The caterpillars may be found from May to September, and the adult moths may be taken any time from the end of June up to and including September. The Vapourer Moth is found in Europe, N. Africa, and Western Asia. In Europe and over Britain and Ireland it is common, and is to be found in towns as well as in the country.

Description of the Insect.

Moths.—There is a marked difference between the male and female moths. The *male* measures from 1 inch to $1\frac{1}{4}$ inch in expanse of wings. The body is brown; the wings are ochreous or chestnut brown, the fore-wings having dark markings. Near the hind angle of each fore-wing is a somewhat crescent-shaped clear white spot. The antennæ are double-combed. The *female* is yellow-grey in colour, hairy, and unable to fly, the wings being reduced to mere stumps. The antennæ are saw-like or single combed.

Egg.—The eggs are whitish-grey in colour and laid in great numbers. Examined with a lens they are seen to be round, but somewhat flattened on the upper side.

Caterpillar.—The 16-footed caterpillar presents a very gay appearance. It is very hairy, long light-coloured hairs springing from reddish warts all down each side of the body. Tufts of yellow or brownish hairs are very conspicuous on the back on segments 5, 6, 7, and 8, two tufts to each segment. Conspicuous also are two dark-coloured tufts springing from behind the head and pointing over it; similar tufts project one from each side of segment 5, and also a long slender one at the tail end. The under side of the caterpillar is yellowish. The full-grown caterpillar measures up to 2 inches.

Pupa.—The chrysalis is yellowish and lies under cover of a somewhat oval-shaped yellow-grey web or cocoon. Mixed in the web are the hairs of the caterpillar.

Life History.

The male moths are active fliers, but the females are very sluggish. On issuing from the cocoon the female settles on the outside of the cocoon, and after pairing lays, on and all round the cocoon, eggs up to 300 and over. Some of these eggs hatch in a fortnight to three weeks, others taking longer, while some from the same laying may not give out their caterpillars until the next year in late spring. This means that all stages of the insect from egg to adult may be met with at the same time. The young caterpillars soon after hatching scatter over the tree. When the caterpillars are full fed they spin their cocoons, these being attached to leaves or twigs, or crevices in the bark. The pupation stage may be completed in three weeks. Two broods in the year are possible. If the eggs that have over-wintered hatch in the early part of May, pupation of the resulting caterpillars may take place in time for a second brood of moths by September. On the other hand there may be only one generation in the

year—*i.e.*, moths developed in summer as a result of eggs laid in the previous year, and not hatching till after the winter, may go on to egg-laying in their turn, but these eggs may not hatch in the same year in which they are laid. The practical point, however, is that, owing to the overlapping of generations, caterpillars may be found all the season from May till September.

Preventive and Remedial Measures.

1.—The best way to fight the pest is to destroy the egg-masses with the cocoons, especially in winter.

2.—It should be remembered that as the females are wingless, attack may be expected to repeat itself in the same locality and with an increased number of enemies.

3.—Where the caterpillars have got to work they should be shaken off the plants and destroyed.

4.—Spraying the plant, where practicable, with Paris Green, in the proportion of 1 lb. of Paris Green to 200 gallons of water, would poison the food of the caterpillars.

4, Whitehall Place, London, S.W.,
May, 1906.

The Board of Agriculture and Fisheries would be glad if recipients of this leaflet would make it known to others interested in the subject. Copies may be obtained free of charge and post free on application to the Secretary, Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W. Letters of application so addressed need not be stamped.

BOARD OF AGRICULTURE AND FISHERIES.

Fumigation with Hydrocyanic Acid Gas.

During the past few years the method of destroying various insect pests by means of fumigating with hydrocyanic acid gas has been much advocated, and the recommendation has been made in certain of the Board's leaflets. For the destruction of mussel scale, woolly aphis, mealy bug, thrips, weevils, and red spider in greenhouses, &c., the method is very valuable, while it may also be employed for the fumigation of poultry houses in case of infestation by lice and mites.

Nursery stock fumigated with hydrocyanic acid gas before planting will be freed from insect enemies in all stages save that of the egg.

Materials to be used.

The materials necessary for purposes of fumigation are :—(1) potassium cyanide of 98 per cent. purity ; (2) sulphuric acid of a specific gravity of not less than 1.83 ; (3) water ; (4) jars and a glass measure.

The following quantities may be taken as a standard for use :—Potassium cyanide 1 part, sulphuric acid $1\frac{1}{2}$ parts, and water $3\frac{3}{4}$ parts.

The proportions of cyanide, sulphuric acid, and water to be used, and the amount of space per unit of cyanide, vary slightly as recommended by different authorities, three different workers recommending 1 oz. of cyanide of 98 per cent. purity to every 200, or 300, or 500 cubic feet of space respectively.

The variation in the amount of cyanide depends to some extent on the character of the plants that are being treated, on their strength, whether they are dormant or active, evergreen or deciduous, and also on the season. In the case of tender plants, 1 oz. of cyanide may serve for 500 cubic feet of space, while hardy plants may be treated with 1 oz. of cyanide to 200 cubic feet of space.

Treatment of Greenhouses, Conservatories, Nursery Stock, &c.

Method of Application.—The glass-house or other place which is to be treated must be rendered as airtight as possible.

The sulphuric acid should be poured very carefully and slowly into the water, which may be put in an earthenware vessel, *e.g.* a large jam-jar. The cyanide of potassium, wrapped in thin blotting paper, should then be dropped into the now diluted sulphuric acid. The vessel into which the cyanide is

dropped must be so near the door that it can be reached by the outstretched arm of the operator, who should *immediately* shut the door and close up its chinks by paper previously prepared. Another, and better, method is for the operator to introduce the cyanide to the diluted sulphuric acid through a window, the cyanide being placed at the end of a long stick or rod, or being lowered into the acid by a string and pulley. The window must be closed immediately after the addition of the cyanide, so that the operator may escape the fumes. Strawson recommends the pouring of the diluted acid from a bottle fitted with a cork in which two slits are cut, one to let in air and the other to allow a small and even stream to flow upon the cyanide, the object being to provide a slow and even disengagement of gas. The bottle should be arranged so that it can be tilted up when all is ready.

It is of importance also that the hydrocyanic acid gas fumes be distributed over the house, and this may be done by an arrangement of fans which can be worked from the outside.

Fumigation should take place in the evening, or after nightfall, and not in strong sunlight. The temperature of the house should be from 50 degs. F. to 60 degs. F. The plants to be treated should be dry. The surface of the soil of the house should also be as dry as practicable. Experiment has shown that the eggs of the Woolly Aphis* may remain unaffected, and therefore fumigation should be repeated in ten days. Eggs of the Apple Mussel Scale† are also unaffected by gas of the strength mentioned.

Points to be Carefully Noted.—The work should be done by a careful and skilled operator, for the cyanide and its fumes are very poisonous and dangerous to human and animal life.

The treated room or conservatory must be kept closed during fumigation from three-quarters of an hour to an hour, after which the room should be ventilated, the windows, &c., being opened from the *outside*, and no one should enter until an hour has elapsed. While opening the windows, &c., the operator should be careful not to inhale the escaping fumes.

It is safer not to fumigate when the plants are in bloom.

Nursery Stock.—In the treatment of nursery stock the bushes or young trees should be placed in an airtight box or canvas tent of known capacity and subjected to the fumes of hydrocyanic acid gas for one hour. Large numbers can be treated at once at little expense.

When the time has expired the tent or box should be opened in such a way that the wind blows the fumes away from the operator, and should be left to ventilate for half an hour before the stock is removed.

Trees in the orchard may also be treated by the use of a canvas tent or cover.

* See Leaflet No. 34.

† See Leaflet No. 107.

Canvas Covers for Fumigating.

The practice of using canvas covers for fumigating is not so common in Great Britain as in some other countries, and the method followed in the Colonies may here be given for the guidance of those who wish to undertake orchard fumigation with hydrocyanic acid gas. According to Claude Fuller, the Natal Government Entomologist,* the covers should be of a light, durable material, and comparatively gas-tight, the most suitable probably being canvas. Eight-ounce American duck canvas is recommended.

There are three types of covers: sheets, tents, and box covers. The *sheets* are octagonal in form, and can be further enlarged by sewing on a "skirt" round the edge. These can be easily lifted over small trees up to six or seven feet in height, above which a hoisting apparatus must be used. *Tent covers* may be used for trees up to 13 feet in height. They take the form of dome-shaped tents, the mouth of which is kept open by a ring of gas-piping passed through canvas loops, and they can be quickly lifted over and removed from 8 to 13-ft. trees by a couple of men, where the hoisting of a sheet would take three or four. *Box covers* are made to any convenient size by covering a wooden framework with canvas or calico; the latter material should be painted or oiled to make it sufficiently gas-tight. They are especially adapted for small trees and bushes.

Note.—As both the potassium cyanide and the hydrocyanic acid gas are deadly poisons, the former should be kept in a tightly stoppered bottle and labelled *Poison*, whilst the gas as generated must on no account be breathed. Fumigation should not be carried out in a high wind, nor when the trees are wet, but otherwise it may be done at any season of the year.

* "Natal Agricultural Journal," July 28th, 1905, p. 697.

4, Whitehall Place, London, S.W.,
January, 1908.

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* Leaflet 71 is not issued separately.

‡ Also issued in Welsh.

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